CINEMATRONICS INC.

SERVICE MANUAL

TAILGUNNER

CINEMATRONICS, INC.
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El Cajon, California, 92020

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OPERATION AND MAINTENANCE

MANUAL

CINEMATRONICS, INC.
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1466 Pioneer Way
El Cajon, Calif. 92020

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In order to provide the very best service possible, the following procedures for ordering or returning parts must be followed:

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2. Advance replacement items may be obtained only during the term of the Warranty and when such items are available, using the same procedure as when ordering parts. When ordering a PCB, please include with your order the game serial number and the number of the PCB you wish replaced.

3. All items received as advance replacements will, after a period of thirty (30) days, become the property of the Distributor, with applicable charges applied in the event Customer Service has not received the defective item against which the advance replacement was made.

4. The Distributor must call this facility for an RMA number prior to returning any item. Please be prepared to provide us with the game serial number and the PCB number when requesting an RMA.

5. In all situations covered above, and in all other situations, the Warranty offered by Cinematronics, Inc. is appicable and should be fully understood.

6. Parts returned for service must be packaged so that no damage is incurred during the shipment. Cartons without a prominently displayed RMA number will not be accepted. Full documentation including game serial number. PCB number and reason for return must accompany parts. Ship prepaid to:

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Customer Service Department
1466 Pioneer Way
El Cajon, CA 92020

800-854-6577 714-440-2933

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INTRODUCTION

Tailgunner is a one player game with dual controls providing ease of operation for right and left handed players. The video display generates 2 levels of intensity, and the audio system generates 6 different sounds during play. The player has control over a moveable sight on the screen by means of a proportional joystick control, which is used for aiming at oncoming spacecraft as they appear on screen. The player has control, by means of a fire button, over a Phasor cannon which, when depressed causes two energy bursts, originating from the bottom corners of the screen, to intersect at the current location of the moveable sight and destroy enemy spacecraft. The player also has control of an energy force shield. When this is activated, it appears on the screen and prevents any enemy spacecraft from passing by. Shield time counts down as used (at the rate of 5 units per second), and once the shield energy reaches zero the shield cannot be reactivated and the player must rely on his skill at destroying ships with his Phasor cannons to prevent any ships from passing by. As soon as ten enemy spacecraft have passed off screen, the game is over. Spacecraft enter the screen in groups of three, and until all three have either been destroyed by Phasor fire or passed off screen, another group will not enter. As more ships are destroyed, the succeeding groups become more evasive and move faster. After inserting the necessary amount of money (one or two coins), 1 credit will be displayed on the screen, and when the start button is depressed the game begins. The amount of shield energy can be changed by switches on the CPU Board, as can the amount of coins per credit.

SECTION 2

INSTALLATION

RECEIVING INSPECTION

Your game was shipped in ready-to-play condition. However, after removal of the shipping carton, a brief visual examination is suggested.

Naturally, you'll want to make note of any physical damage to the game cabinet and its external components for freight claim purposes. Considering the quality of the shipping carton, any damage to the exterior would indicate possible interior damage as well.

The "guts" of the game should also undergo a brief examination for: loose mounting hardware (check to be sure that the major components are still securely mounted); disconnected or loose wires, cables or harnesses; electronic devices loose in their sockets; etc.

At this time the game serial number should be logged. Please remember that the game serial number will be required if you need service from your distributor.

ELECTRICAL REQUIREMENTS

Unless specified otherwise, your game was shipped to operate at 115 VAC, 50/60 Hz. Two other voltage settings are possible. The power supply chassis has a table which shows the voltage options and fusing requirements.

A good earth ground is essential for the proper operation of this game or for that matter any electronic device. Problems with instability and erratic operation of computer-type devices can usually be traced to an ineffective ground system.

INITIAL ADJUSTMENTS

NOTE

When the game is connected to AC power, one of the game sounds may be heard. This is normal.

The audio level (volume) can be easily adjusted and THIS IS ACHIEVED BY ROTATION OF THE ONLY CONTROL ON THE AUDIO CIRCUIT BOARD. The audio level should compete with other machines "on the floor" to maximize play time.

Display brightness is another easy adjustment. The monitor assembly has several adjustments, but the brightness control is the only one which does not require a "screwdriver" for rotation. Keep the brightness at the correct level for appeal.

OPERATOR OPTIONS

The option switch is located on the logic or game board. It is not necessary to remove the board from the cabinet to set the options. In fact, the option switch and audio control can be reached easily through the coin door opening. Table 2-1 will assist you with your selections:

LOGIC BOARD OPTION SELECT TABLE

The following chart diagrams the switch settings of the option switches for "TAILGUNNER". The 7 station switch is located at position E-2 on the logic board.

SWITCHES	SHIELD POINTS								OPTIONS: Coins Per Credit	
	15	20	30	40	50	60	70	80		
Switch #1	ON	ON	OFF	OFF	ON	ON	OFF	OFF	X	X
Switch #2	ON	OFF	ON	OFF	ON	OFF	ON	OFF	X	X
Switch #3	X	X	X	X	X	X	X	X	OFF	ON
Switch #4	X	X	X	X	X	X	X	X	X	X
Switch #5	X	X	X	X	X	X	X	X	X	X
Switch #6	ON	ON	ON	ON	OFF	OFF	OFF	OFF	X	X
Switch #7	X	X	X	X	X	X	X	X	X	X

NOTE
ON = CLOSED = LOGIC 0
OFF = OPEN = LOGIC 1
X = NO EFFECT

SECTION 3

GENERAL INFORMATION

SECTION 3

GENERAL INFORMATION

Your Cinematronics game is designed much the same as conventional video games. The major exception is the use of an alternate means of visual display ... the patented Vectorbeam tm* monitoring system.

However, the game is built of the same basic building blocks as any other video game:

The Power Supply provides all necessary voltages for each separate electronic assembly as well as the AC lighting required throughout the game.

The Central Processing Unit contains circuitry to strobe and interpret all input functions which include the player control panel switches and all coin and credit information and generates all the digital signals used to provide the visual display and control the audio effects. It also contains all the software (i.e., machine language and game personality memory) needed to control the game operation and to generate the proper vectors for the display.

The Audio Board consists of a noise generator and wave shaping circuits which produce different game sounds on command from the CPU logic board.

The Vectorbeam tm* Display Electronics is the final form of interpretation of the CPU's calculations. The CPU logic informs the display electronics unit of information regarding line length and line placement on the CRT. This is accomplished with two twelve-bit words each for horizontal and vertical deflection, and a number of other controlling signals for the cathode drive circuit and switching of the deflection circuits.

The major difference between the vector generator and raster scan type monitors is the means by which the cathode beam is directed (deflection) across the screen.

In the raster scan type of display, the electron beam from the cathode to the anode of the CRT is constantly deflected (scanned) across the face of the CRT in a series of horizontal lines that trace from the upper portion of the screen to the bottom in a synchronous pattern. Vertical information is forming a matrix-type pattern of mathematically possible illumination points on the face of the CRT. If the cathode current is increased at these points on the screen in matrix-type patterns (similar to placing dots on a piece of graph paper where the lines intersect) coherent video in the form of shapes and alpha-numerics to form game backgrounds can be displayed.

The vector generator takes a slightly different approach to cathode beam deflection. The results are a much higher degree of resolution and much smoother motion across the screen. Rather than using a constantly scanning cathode beam, the beam is directed only to points of eventual illumination, using a vectoring form of programming rather than a matrix approach. Basically, the cathode beam is directed between two determined points, and illuminates the entire path of phosphors between these two points, unless blanked by stopping cathode current (i.e., when the beam moves from one star to another on your screen). The ability to illuminate the entire path of phosphors crossed by the electron beam, in any direction desired, (which is not possible in a raster scan system) creates a

much higher degree of resolution than can be found in a raster scan system while at the same time creating a much greater number of angle possibilities. This is also supported by the ability to accommodate two twelve-bit words of information, twelve each for vertical and horizontal deflection, and the fact that there is no background illumination from a constantly scanning beam when brightness is turned up. The higher degree of resolution combines with the totally blackened background generating an appearance of depth not found in a raster scan system.

Another major design difference is the fact that no sync. signals are needed to produce vectors on the CRT. This greatly simplifies the hardware design of the system, and therfore the understanding of the theory of operation, both the CPU logic and the display electronics.

*Vectorbeam ^{tm*} is Cinematronic's service mark for video game repair and education services.

SECTION 4

VECTOR THEORY

SECTION 4

VECTOR THEORY

In order to understand the basic concept behind a vector generated display, it is important to have a basic knowledge of vector theory.

As mentioned in the general information section of this manual, the raster scan display uses a matrix type display pattern. A graphical representation of a matrix is shown in Figure 4-1.

For example, to produce a line on the CRT with a matrix-type pattern, the appropriate intersection points of horizontal and vertical lines are illuminated. The calculations which select these points are made on the logic board, and converted into video information for the monitor to digest. Although there are spaces between the illuminated points, the illusion of a solid line is made by your eyes, and the resolution is determined by the number of available horizontal and vertical lines in the system, and the speed of the sweep.

In the vector display system, there are no horizontal and vertical lines (no sweep) or sync. A line generated using a vector system is shown in Figure 4-2.

A line is drawn by programming a beginning and ending point of the line to be drawn, and forcing the cathode beam to travel between these two points, illuminating the entire path of phosphorus on the CRT. The angle of the line, the position of the line, and the length of the line are determined simultaneously, and simply, by selecting the proper voltage levels for the beginning and ending points of the line.

This is accomplished by the two twelve-bit codes (words) applied to the DAC-80s on the display board. The DAC-80 will produce a different voltage level at its output for each possible combination of input levels (of which there are 4096 possiblities for each 12 bit word.)

It is also important to remember the function of the LF 13331 analog switch and its output RC network. Because we are dealing with reactive components in C101 and C201 on the display board the charging voltages found are non-linear by nature. (See figure 4-3.)

Therefore, when a line appears on the CRT, it is actually only part of the entire path taken between the beginning and ending points of the vector (C-D). The section of A-B is chosen as the most linear portion of the charge curve, and is iliuminated.

Sections C-A and B-D are blanked at the cathode, and points A and B chosen by controlling the analog switch on the display board. These calculations are all performed on the CPU logic board.

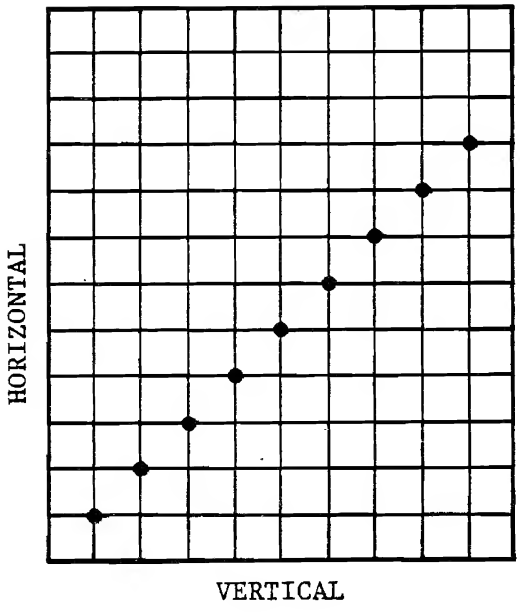


Figure 4-1. Graphical Representation of a Matrix

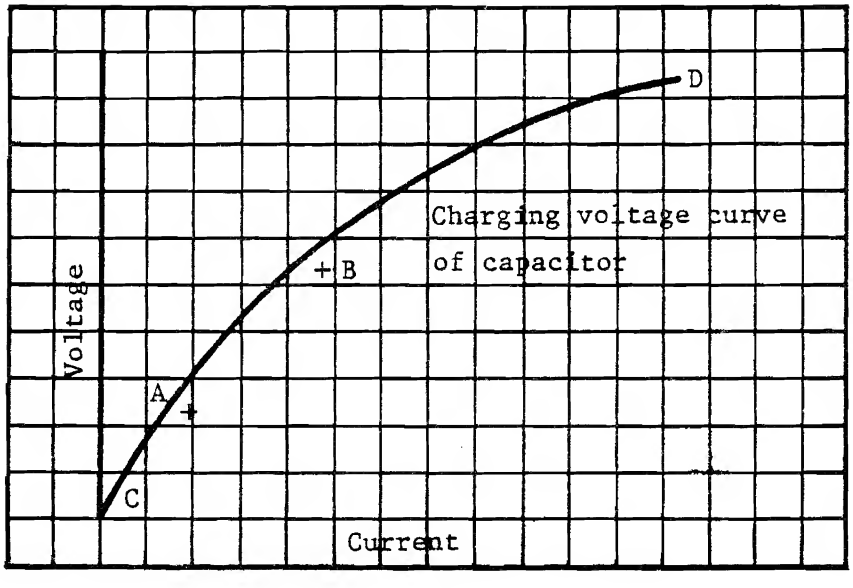


Figure 4-3. Non-linear Charging Voltages

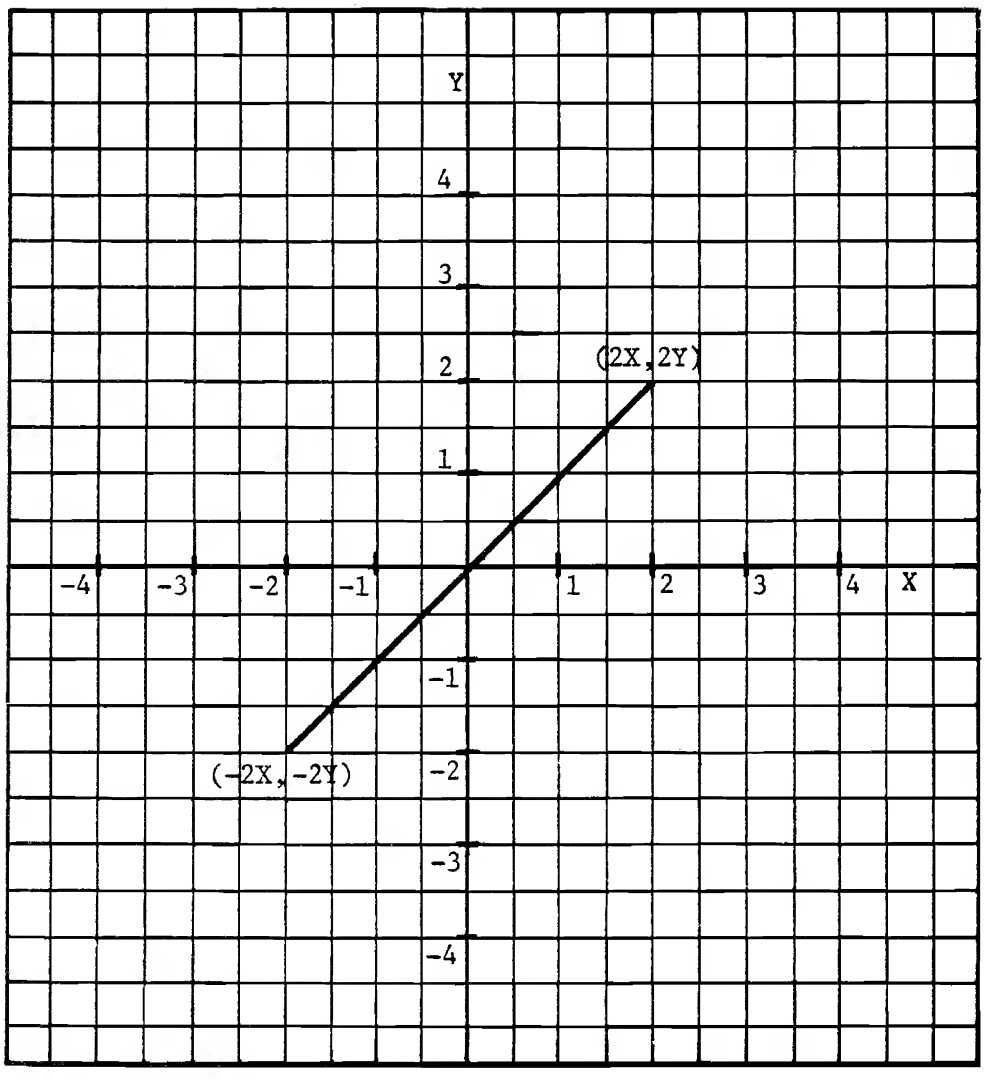


Figure 4-2. Line using Vector System

When a line appears on the CRT, it is actually only part (section A-B,) of the entire path taken between the beginning and ending points of the vector (section C-D). Section A-B is chosen as the most linear portion of the charge curve, and illuminated.

Sections C-A and B-D are blanked at the cathode, and points A and B chosen by controlling the analog switch (V-1) on the display board. Again, these calculations are all performed on the CPU logic board.

SECTION 5

THEORY OF OPERATION

SECTION 5

THEORY OF OPERATION

GENERAL DESCRIPTION

This section describes the principles of operation of the major circuit functions of the Cinematronics Video Arcade Game. The system's general functional description is followed by detailed circuit schematics which are included as Appendix A. The schematics used in this manual are similar in nature to those used by most industrial electronic firms.

MONITOR DISPLAY

The Vectorbeam tm monitor is unlike the conventional TV monitor in that it displays vectors (lines) generated from X-Y coordinates recieved from the logic board. The horizontal points are X (width) and the vertical points are Y (length). The X and Y logic signals originate from the logic board.

The Vectorbeam tm monitor can be divided into two basic sections: one is the deflection amplifier and the other is the voltage and cathode drive circuits.

The deflection amplifier can be further divided into two identical channels: one for the vertical deflection and one for the horizontal deflection. The operation of the vertical channel will be discussed; however, the same theory of operation pertains to the horizontal channel.

Digital information, in the form of a twelve-bit word, is applied to the input of the DAC-80 digital to analog converter (U101) on pins one through twelve. The most significant bit is applied to pin one, and the least significant bit is applied to pin twelve. The DAC-80 makes the necessary conversion from digital signals to analog signals which are outputted as analog voltage signals on pin fifteen (proportional in level depending on the input word applied). The result is a positive and negative voltage signal about its reference voltage. Remember, there is no "sync" signal present, and the signal is not true video as seen in raster scan monitors.

From the DAC-80 the analog signal is then sent to a high-speed analog switch, (U1). The analog switch has two parallel inputs for the display signal, and two controlling inputs which select one of two outputs from the switch. An R.C. network, which is used to create line length and line position on the screen is found at the outputs.

Output fifteen from the switch routes the analog signal through a 5K potentiometer (R102), a 10K resistor, (R103) and to the input of U102 op-amp. The time constant developed by these two resistors and the capacitor (C101) determine the length of the vector line seen on the screen. Adjusting the potentiometer will adjust the length of the vertical lines seen on the screen.

Output ten from the analog switch routes the signal directly to the input of U102 op-amp, and the resulting time constant of the op-amp input impendence and the capacitor C101 determines the position on the screen of the vector line.

Op-amp, U102, serves a dual purpose: it acts as a buffer between the deflection amplifiers and the analog switch, as well as an "edge gain" amplifier (i.e., height).

At the output of U102, there is a resistor diode network consisting of R105-R110, and CR101-CR104. This resistor diode network is used to compensate for the non-linear characteristics of the CRT near the edges of the screen. If this circuit were not used, any object displayed on the screen would increase in size as it moved closer to the edges of the screen. Potentiometer (R109), adjusts the height of the pictures.

From the wiper of R109, the signal proceeds to Q101, which is the first stage of deflection amplification. Q103 is emitter coupled with Q101 to provide a degenerative feedback loop from the yoke. Q102 is used to provide a constant current source to both emitters.

At this point, the deflection circuit can again be divided into two identical circuits. One circuit, which controls the lower half of the screen, is comprised of Q104, Q106, Q108, and Q110. The other circuit, which controls the upper half of the screen is comprised of Q105, Q107, Q109, and Q111. **

Q104, Q108 and Q110 are three stages of amplification, while Q106 is used as current limiting protection for Q108 and Q110. The same holds true for the other configuration of Q105, Q107, Q109 and Q111. R124 through R129 are used as a current divider network for the yoke.

R122, R123, and C102 form a RC network, which compensates for any counter EMF that may develop by the expanding and collapsing of the deflection coil's electromagnetic field.

The high voltage and cathode circuitry is the second section of the monitor. This section also contains the necessary voltage regulation to power the ICs located on the display board as well as develop the high voltage.

U4 and U6 provide plus 15V and minus 15V respectively to power the DAC-80s and the TL081 op-amps on the display board.

U3 and U5 provide plus 18V and minus 18V used in the high voltage transformer (T-1) and oscillator (the oscillator circuit is necessary because there is no horizontal sync. used to develop the high voltage pulses.) The oscillator circuit is comprised of primary windings, Q4 and associated discreet components.

The high voltage 18KV is developed by T1 secondary windings, and the high voltage tripler.

The intensity and beam blanking control circuitry is composed of U7, Q1, Q2, Q3, Q8 and associated components. The cathode voltage rides at +88. The beam is turned on by a more negative voltage. At the anode of CR4 negative pulses can be seen, these are the beam on pulses. For normal intensity the pulses will go down to approximately 40V, for double intensity, 20V. Pins 3 and 4 of U7 is the normal intensity control gate which receives information from the CPU. Pin 1 and 2 is the double intensity control gate. When a Hi going Lo signal is on pin 3 of U7 pin 4 will be a Lo going Hi turning on Q3 on the Hi transition. Q3 acts as a switch connecting the series network of R11, R9 and R10 to ground creating a voltage divider network. R11 is the manual intensity control. When 2 of U7 goes Hi Q1 turns on for the duration of the pulse connecting just R9 and R11 to ground, thus lowering the voltage at the anode of CR4 lower still because of the lower resistance, than with normal intensity. Q2 is used as a switch to enable Q1 and Q3. Its purpose is to shut off the beam when the power is turned off. Q8 is a beam on delay to prevent phosphor burns if someone was to unplug and plug in the machine rapidly.

R111 is the brightness potentiometer, which adjusts the amplitude of the negative spikes used for brightness and intensification.

** In the horizontal section of the deflection amplifier, Q204, Q206, Q208 and Q210 control the left hand side of the screen, and Q205, Q207, Q209, and Q211 control the right hand side of the screen. By dividing the screen in this manner, four quadrants of deflection area have been developed (refer to Vector Generator description).

CPU BOARD

The processor hardware can be broken down into five basic functional blocks as shown in Figure 5-1. The arrows indicate the possible data flow directions between the various blocks. The ALU and Control block are the main components of the processor while the Memory and I/O blocks may be thought of as merely peripherals. Figure 5-2 is a detailed block diagram of the processor. The numbers in each block correspond to the entries in Table 5-1, which lists the IC numbers of the main components of each functional block.

The following is a brief description of each block shown in Figure 5-1. The numbers beside each functional block name are the numbers in Figure 5-2 which correspond to a particular function.

RAM (6)

The RAM is implemented with three read/write static memories configured as a 256 x 12 bit block. Data can be transferred to or from this memory via the ALU block. The processor uses this RAM as a scratch pad.

ROM (10)

The ROM is configured as an 8K x 8 bit block of memory. These memory locations contain the program instructions and/or data. It is accessed via the processor control unit.

I/O 19, 17, 18

The I/O block consists of 8 output lines implemented with a bit addressable latch, 24 input lines implemented with data selectors, and two 12 bit registors which are connected to the X Y display deflection circuits via D/A convertors.

Arithmetic Unit 1,2,3,4,5

The arithmetic unit performs all the arithmetic processing for the system. It consists primarily of two 12 bit accumulators, an arithmetic logic unit and various data selectors. The accumulators can function as temporary storage registers for arithmetic functions upon the data in the accumulators. The data selectors are used to select the various sources of data which will be processed.

Control Unit (15,16,14,7,8,9,11,12,13)

The control unit is the heart of the processor. It performs all instruction decoding operations and generates all the necessary control signals which the rest of the hardware requires to function correctly.

The following is a discussion of each block shown in Figure 5-2.

1. Accumulator Selector

The accumulator selector consists of 3 quad data selectors. They are used to select the output of either the primary or secondary accumulator for processing by various other sections of the systems.

2 & 3 Primary and Secondary Accumulators

The two 12 bit accumulators are implemented with quad bidirectional shift registers. The primary accumulator consists of S4, P4, M4. The secondary accumulator consists of T4, R4, N4. All data manipulation in the processor is accomplished using these two accumulators. All output data flows through these registers.

4. Arithmetic Logic Unit (ALU)

The ALU is used to perform all necessary arithmetic functions within the processor. The ALU is implemented using three 24LS181 (N6M6L6) function generators, three 74LS85 (N9,M9,L9) 4 bit magnitude comparators, and a 74S182 (L4) look ahead carry generator. The data which the ALU manipulates can come from four different sources. The first source is the contents of the accumulators via the accumulator selector. The second and third sources are the ROM and RAM data outputs via the ALU data selector (N11, M11, L11) and the fourth source is the external input selector (E4, D4, C4).

5. Data Selector

The data selector is used to read data into the ALU from either the RAM or ROM memory. Note that the ROM data is only 8 bits wide while the RAM data is 12 bits wide.

6. RAM Storage

The system RAM consists of three 9101C high speed static memory chips connected as a 256 x 12 bit block. The block is 12 bits wide in order to allow the contents of an accumulator to be stored. The processor uses the RAM as temporary storage of program variables, data pointers or any other data of a dynamic nature.

7. RAM Address Selector/Register

The output of this register is tied directly to the address lines of the RAM. It consists of a multiplexer which routes address data from either the ROM or RAM locations to the RAM address lines. The capability to use RAM data to select RAM addresses is the basis for the indirect addressing mode of the processor.

8. Page Selector

The page selector is used to latch the high order 4 bits of a RAM access instructions.

9. ROM Data Register

The register is used to temporarily hold data from the ROM during an instruction fetch.

10. ROM Memory

The ROM memory consists of the actual memory chips plus a data selector and latch circuit. The latch is used to improve the memory access time during a two byte instruction fetch by allowing one byte of the instruction to be latched while the RAM address lines are decoded for the other byte. The data selector can then be used to rapidly access both bytes of the instruction by switching between the latch and memory outputs.

11. Instruction Register

The instruction register is a latch which holds the current op code as read from ROM. Its output is tied to the instruction decode circuitry which in turn generates the necessary signals to execute the instruction.

12. System Sequencer

The system sequencer is used to decode an instruction op code and to generate the appropriate timed sequence of signals which execute the instruction. The op code is decoded by using it as the address data to a set of decoder ROMS. The outputs of the decoder ROMS are then synchronized with the system clock and used to control the various system functional blocks.

13. Line Length Counter

The line length counter is used during the process of drawing a vector to control the length of a vector, by turning off the beam at a pre-determined time after the vector is intiated. The counter is loaded with a value from a line length ROM and then counts up until it overflows which in turn generates a signal to indicate the vector has been finished.

14. Program Address Selector

This selector is used to provide the address data to the program ROM. It selects either the program address counter output or the accumulator selector output and routes this data to the ROM address lines. The ability to use the accumulator contents as address data allows the program to randomly access data tables stored in the ROM or to compute a branch address after a conditional test.

15. Program Address Counter

This is a 12 bit counter whose output defines the next location in ROM to be accessed. It is normally clocked sequentially to step through a program. However, it can be loaded with data from the program address register which is how the jump instructions are implemented.

16. Program Address-Register

This register is a latch used for temporary storage of an address which will be loaded into the program counter during a jump instruction. The input data to this latch can come from either the program ROM or the scratch-pad RAM.

17. Input Selector

The input selector is used to read the state of one of the 24 input lines into the selected accumulator. There are 16 primary inputs and 8 secondary inputs. During an input instruction the upper 11 bits of the accumulator are set to zero while the least significant bit reflects the state of the input line. All input lines have pull up resistors on them so that they will read high if they are left unconnected.

18. Output Selector

The output selector is a bit addressable latch used to control the 8 output lines. During an output instruction the selected output line is set to the complement of the least significant bit of the accumulator. The output lines are used to control the audio board, display intensity and the mechanical coin counter.

19. Display Registers

The display registers are the interface between the processor and the display driver circuits. These registers are latches into which the contents of the accumulators can be stored. The outputs are tied to D/A converters which provide the input voltage to the display deflection amplifiers.

AUDIO BOARD

The sound generation circuitry is composed of the following functional blocks: Audio Power Amp with volume control, Explosion sound, Wideband Noise Generator, Background Rumble, Force Shield Hum, Shield Bounce, Hyperspace, and Phasor Cannon sound. All discrete sounds are tied together at a summing junction and then fed to R70 (The input to the power amp). Each sound is triggered by a low going digital pulse from the trigger port (IC23), which is software controlled by the CPU Board.

FUNCTIONAL BLOCKS

Each functional block is listed on SD205200 by its functional name (Example: Explosion). The Power Amplifier is composed of IC19, Q6, Q7, R75 and their associated components. IC19 is a preamplifier which directly feeds the push-pull power amp, Q7 and Q6. Adjusting R75 will change the amount of feedback to the preamp causing an increase or decrease in volume at the speaker. Under no circumstances should the Power Amplifier drive a speaker of less than 8 ohms impedance.

The Wideband Noise Generator is a common signal source for providing wideband random noise to the discrete audio sections of the board. The noise generator works as follows: diode D1 is a zener diode with random noise levels of typically 200 micro volts generated at its internal junction. This noise will be present at the anode of D1 across resistor R1. The noise is amplified by a factor of 1000 by IC1 and coupled to IC2. IC2 is a band equalizing signal limiter which will balance out the amplitude of the noise frequencies by amplifying the weaker signals

and attenuating the stronger signals. The output of IC2 should appear as wideband clipped noise with an amplitude of 1.2 volts peak to peak. IC3 will amplify the noise to approximately 5 volts peak to peak at which time it is ready for use by the sound circuits.

The Explosion sound functions as follows: Wideband noise is filtered by IC9, which is an op amp integrator, and injected into pin 2 of IC10. A negative going pulse of approximately 400 ns from pin 4 of IC23 fires a one shot,IC12. The output of IC12 then goes to 5 volts for a time determined by the RC time constant of C15 & R39. This brings Q3 into conduction charging C16 to + 5 volts, turning on IC10. Once the pulse from IC12 has ended, C16 will discharge to minus 15 volts causing decaying explosion sound as IC10's output amplitude fades.

The Background Rumble sound utilizes the explosion circuit just explained. By maintaining a low level output from the trigger port on pin 5 of IC6, Q5 is kept in conduction causing IC10 to conduct at a low level of amplification, which is determined by the value of R43. This allows a low amplitude level of noise to be constantly heard at the speaker.

The Shield Hum sound is composed of two 555 square wave oscillators IC16 and IC17. The output of each oscillator is fed into a RC filter network where the square wave is converted into a sinusoidal waveform. The outputs are then combined at pin 2 of IC13. Whenever pin 13 of IC4 goes to a low logic level, Q5 conducts turning on IC13 at an amplitude level determined by the value of R47 until pin 13 of IC4 goes back to a high logic level.

The Shield Bounce sound functions in nearly the same manner as Shield Hum. Two 555 oscillators feed 5 volt square waves into their corresponding dividers IC18. Then the outputs are combined at pin 2 of IC22. Filtered wideband noise is also injected at pin 2 of IC22. IC12 is a one shot which is triggered from IC23. When pin 12 goes to a low level, Q8 conducts charging C44 to + 5 volts and turning on IC22. When the one shot resets it turns off Q8. C44 then discharges to minus 15 volts creating a decaying envelope out of IC22.

The Phasor sound is created by ramping a VCO (IC11), from a high frequency to a low frequency while feeding the signal into a divider (IC8). When pin 4 of IC4 goes to a low level, pin 6 goes low enabling ½ of IC8. At this time pin 4 of IC6 goes from its low state enabling C13 to charge, which changes the voltage at pin 3 of IC11 causing the frequency shift. The output signal is then converted to a 5 volt sqare wave by Q1 and fed into IC8 through IC5. The digital outputs of IC8 are fed into R35-38 and R21, R22, and C8 converting them into an analog signal. When pin 4 of IC4 returns to a high logic level, IC8 is disabled permitting no sound out and C13 is grounded through IC6 causing the VCO to return to its highest frequency.

The Hyperspace sound is created in the same way as the Phasor sound except that instead of low frequency sweep it goes from a low to a high frequency. When pin 1 of IC4 goes low, pin 3 goes low, enabling ½ of IC8. Pin 6 of IC5 goes high and pin 2 of IC6 goes low discharging C6 which sweeps the VCO. The rest of the circuitry is identical to the Phasor sound.

The Trigger port is an 8 bit addressable latch whose inputs come from the output latch on the main logic board through a ribbon cable to J4. The outputs of IC23 are at a high level until the proper commands are received from the CPU board. All sounds are low level actuated.

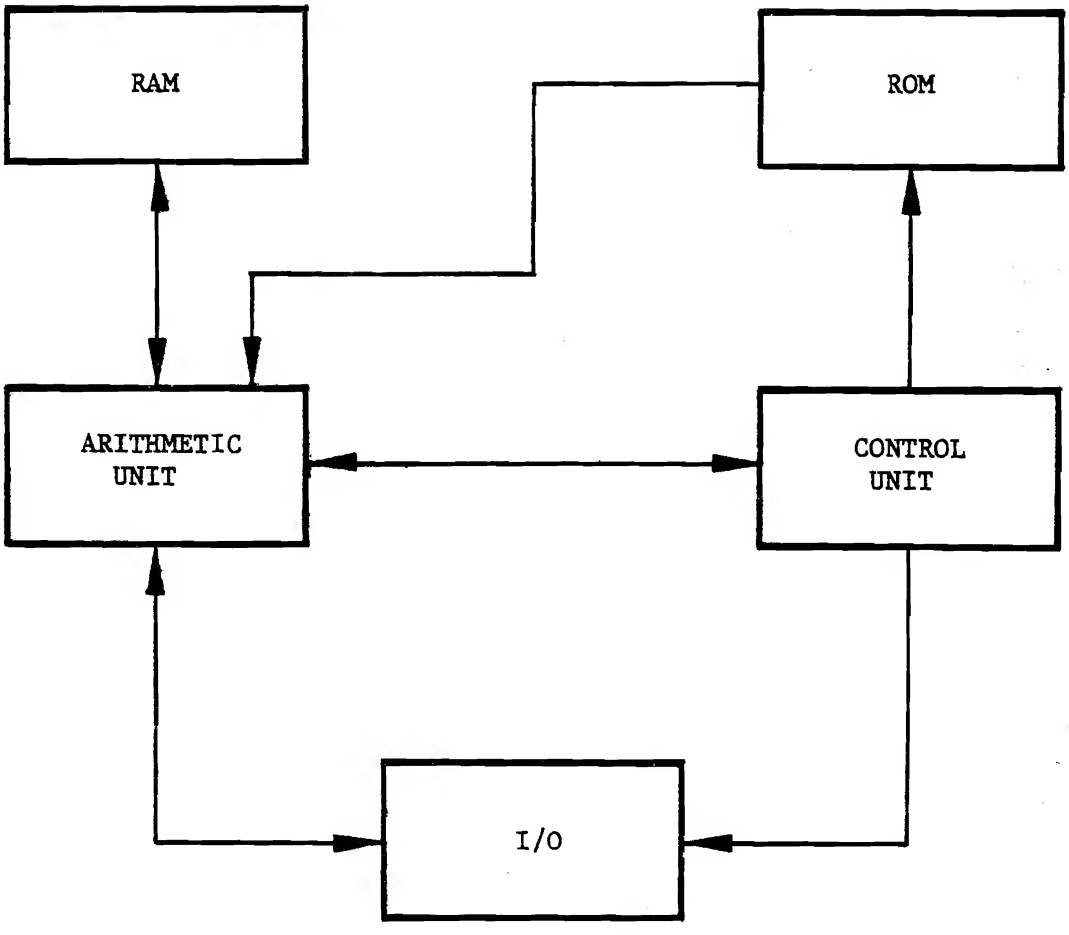


Figure 5-1. Functional Block Diagram

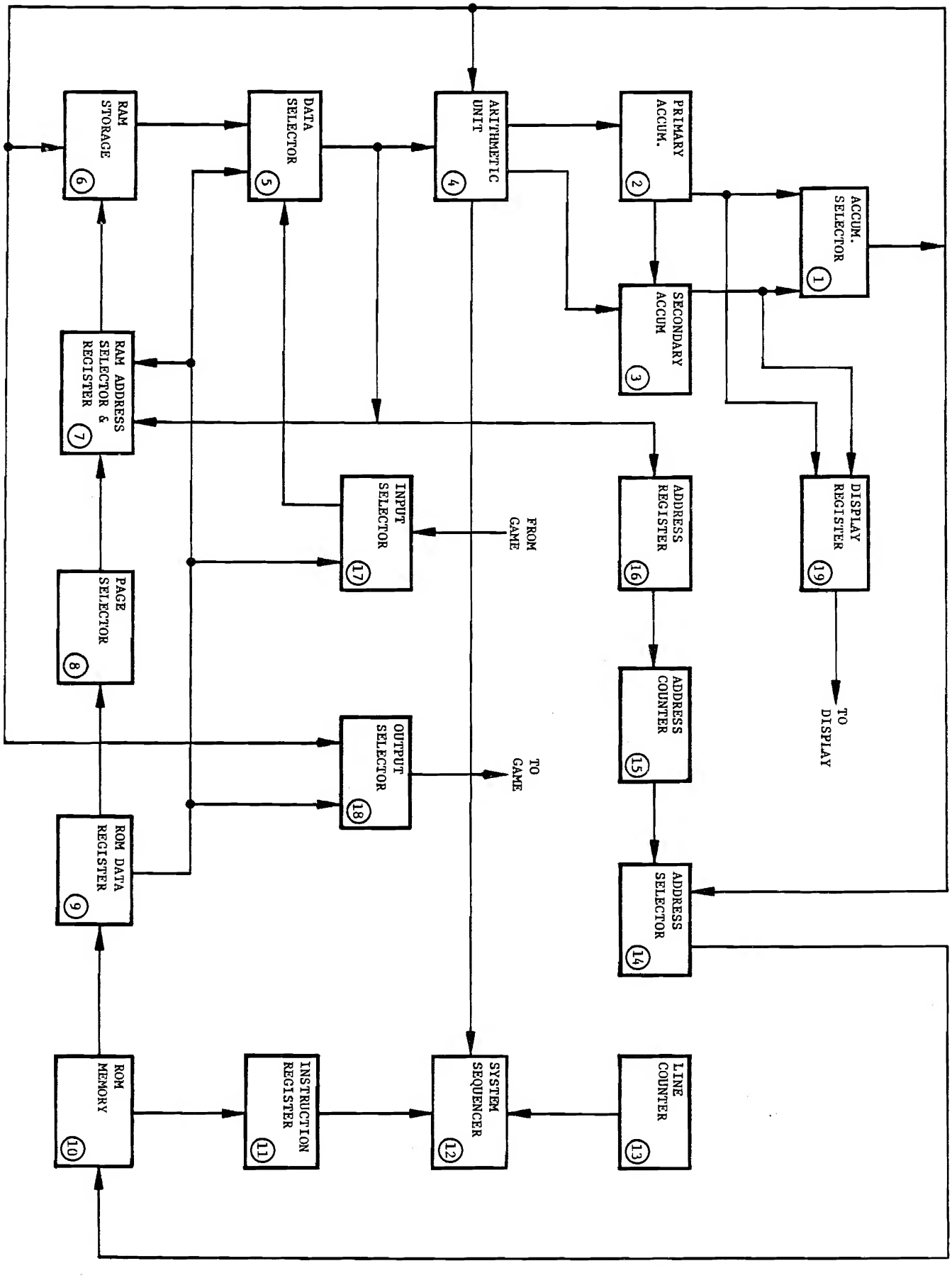
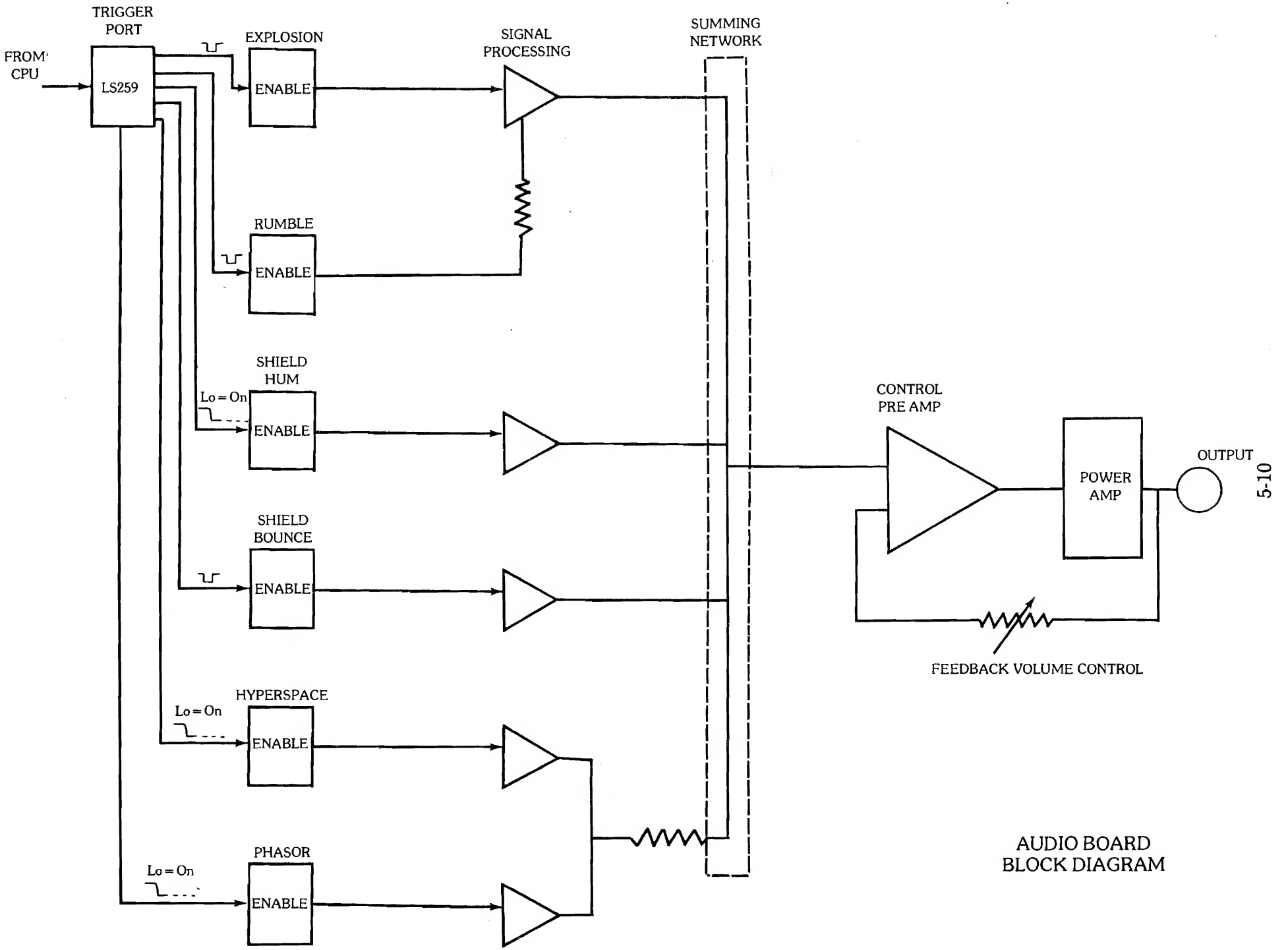


Figure 5-2. Detailed Block Diagram

TABLE 5-1. BLOCK NUMBERS AND COMPONENT I.C.

1. T-2, R-2, N-2
2. S-4, P-4, M-4
3. T-4, R-4, N-4
4. N-6, M-6, L-6, N-9, M-9, L-9
5. N-11, M-11, L-11
6. N-14, M-14, L-14
7. J-12, I-12
8. H-12
9. S-13
10. U-7, R-7, T-7, P-7, U-9, T-9, U-11, T-11
11. T-13
12. A-8, G-10, F-10, G-14, F-14, E-14, D-14, C-14
13. E-6, D-6, E-8, H-8, G-8, F-8
14. S-9, R-9, P-9
15. S-11, R-11, P-11
16. P-13, R-13
17. E-4, D-4, C-4
18. F-2
19. S-2, R-2, M-2

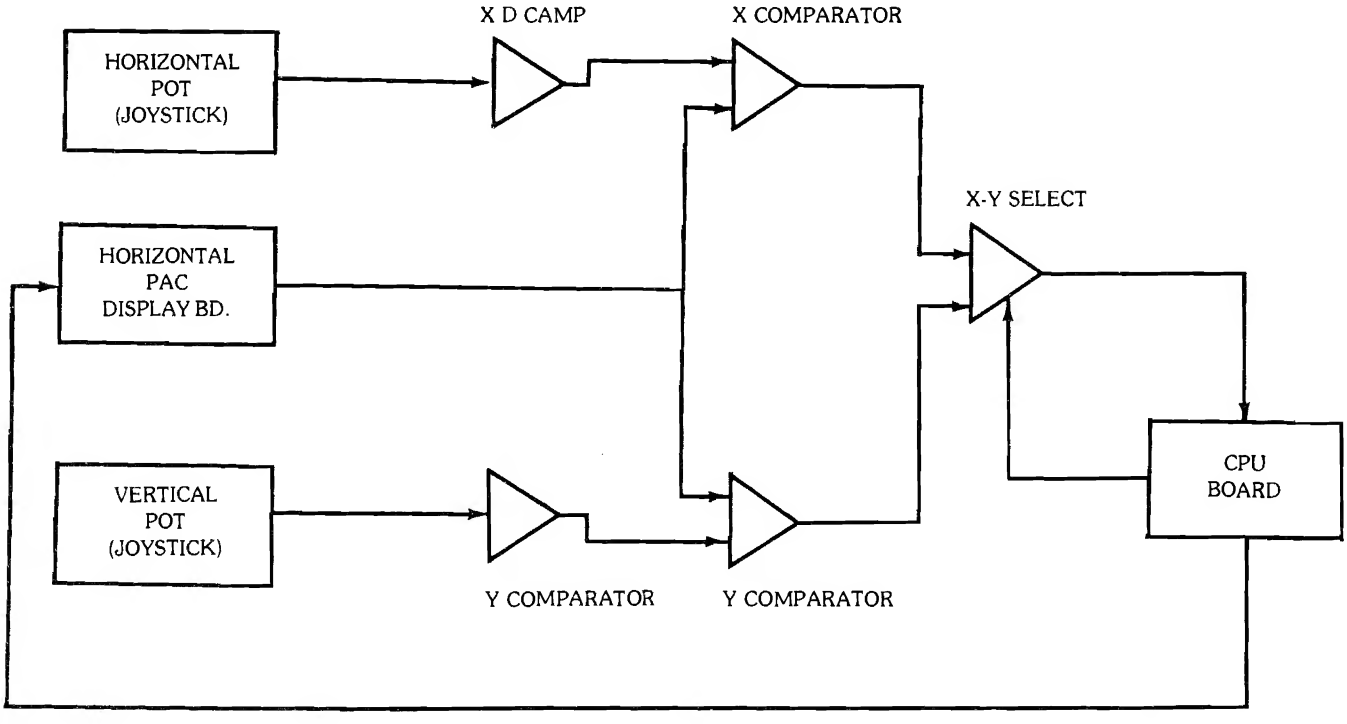


AUDIO BOARD
BLOCK DIAGRAM

JOYSTICK CONTROL CIRCUITRY

The Joystick circuitry is used in conjunction with the CPU Board to perform an analog to digital conversion. The X & Y pots on the joystick control work in the same manner with identical circuitry. One end of each pot is connected to +15 and the other end to -15V. The center wiper of each pot goes to its corresponding circuitry. The voltage off the pot is fed into the input of a noninverting DC amp, the capacitors on the input are used to smooth out the response when moving the joystick quickly to prevent jerkiness, then into a comparator. The other input to the comparator comes from the horizontal digital to analog converter on the display board. The comparator is comparing these two signals and feeding them back into the CPU. The 7406 is being controlled by the CPU to select either the X or the Y signals. The CPU reads the signal from the comparators. For example; take the vertical pot; if the joystick is moved left, the voltage changes and is compared with the output of the DAC, which reflects the actual location of the sight on the screen. Then the comparator reflects the difference and feeds it to the CPU, which then reads this change and outputs to the display board a new location for the sight, in proportion to the speed and location of the pots on the joystick control. This new location is fed back to the comparator on the joystick circuitry and compared again until location matches the position of the joystick control.

BLOCK DIAGRAM JOYSTICK CONTROL CIRCUITRY



SECTION 6

MAINTENANCE

TABLE 6-1. TROUBLESHOOTING GUIDE

PROBLEM	PROBABLE SOLUTIONS
No picture	Listen for audible "clatter" from the Vector circuitry on the display board. If the clatter is present, then the DAC's and the analog switch (LF13331) are operational and the problem is in the intensity circuitry. If game audio is present, the problem is in the monitor. If the audio is distorted or absent, the problem is usually on the logic board. Check IC F-2 pins 4, 5, 6, 7, 9 & 12. Check the neck of the CRT for a glowing filament. If there is no glow check the black and brown wires of the CRT connector for 6.3 VAC between them. Check IC C-8 pin 6 on the CPU with a logic probe. Pin 6 should be low indicating that the CPU is not continuously resetting. Be sure all connections are made to the display board and CPU. Connect a scope to the yellow wire leading to the CRT connector. Set brightness full clockwise. There should be data pulses of 50 volts P-P at an 80-100 volt base. If no data pulses are present, connect a scope probe to pin 2 of IC U7 and check for data pulses. If data is present, check Q1 and Q2 with an ohmeter or a transistor tester. Check J2 pin 14 for +25 volts unfiltered. Check CRT neck for broken pins or other damage. Check the seating of the CRT plug and insure that proper connections are being made.
Narrow line on display	Check for an open winding in the yoke coils. Check for bad connections of yoke wires to display board. Check for continuity between display board and power transistor on heat sinks Q110, Q111, Q210, and Q211. Check for faulty power transistors Q110, Q111, Q210 and Q2211. Also check for broken solder connections on circuit board molex connector socket pins.
Half of picture missing	Left half: Check Q208, Q206, Q210 Right half: Check Q209, Q207, Q211 Top half: Check Q109, Q107, Q111 Bottom half: Q108, Q106, Q110

TABLE 6-1. TROUBLESHOOTING GUIDE (Continued)

PROBLEM	PROBABLE SOLUTIONS
No high voltage	On display board, check DC voltage output of IC U3. It should be +18 volts DC. If not present, check for +25 volts present at the input to U3. Check DC voltage output of IC U5. It should be -18 volts DC. If not present, check for -25 volts present at the input to U5. Lift the winding from pin 3 of the high voltage XFMR T1. Measure +18 volts. If the +18 volts is present, check for a shorted Q4, shorted capacitors C20, and C19, bad diodes CR7, and CR8. Check for 6 kilovolts at black wire of XFMR T1.
Dotted display	Check for faulty analog switch U1. Inspect yoke connections to display board. Check for open yoke windings. Check for proper +25 and -25 volts DC. Check operation of DACS U101 and U201.
No audio sound	Check for an open speaker coil. Check transistors 2N6292 and 2N6107 and other nearby output components on audio board with an ohmeter or transistor tester. Check for open wiper on volume control of audio board. Verify that CPU is fully operational.
Coin counter is inoperative	Check transistor 2N6292 on logic PCB with ohmeter or transistor tester. Disconnect coin counter molex connector. Measure DC voltage on red wire. Meter should read +25 volts DC. Check power connector (J1) to logic board. Check electrical connection at pin 3 to J1.

TABLE 6-1. TROUBLESHOOTING GUIDE (Continued)

PROBLEM	PROBABLE SOLUTIONS
No brightness control	Check intensity pot R11 for open wiper or internal short. Check for open capacitor C17. Check for bad solder connections to R11.
Circuit Breakers Trip	Disconnect power to display board. If circuit breakers continue to blow, check for a shorted speaker coil. Verify that the + 15 and -15 volt regulators are operating properly. Verify that the output power transistors on the audio board are good with an ohmeter or a transistor tester. Check IC C-8 pin 6 on the CPU with a logic probe. Pin 6 should be low indicating that the CPU is not in continuous reset. Measure the voltage at IC T-13 pins 10 and 20 with an accurate voltmeter. The meter should read between 4.8 and 5.1 volts DC for normal system operation. Remove connectors J3 and J4 on the display board and check power transistors Q110, Q111, Q210, and Q211 located on the heatsinks with an ohmeter or transistor tester. Check diodes CR12 and CR15 located on the display circuit board. Disconnect the CRT yoke wires from the display board and remove CRT socket. Re-apply power to the display board and reset circuit breakers if necessary. If the breakers do not blow then check transistors Q208, Q209 and Q204 in the horizonal deflection circuit and transistors Q108, Q109, and Q104 in the vertical deflection circuit with an ohmeter ot transistor tester. Check the horizonal and vertical DACS for proper supply voltages at pins 13, 14, and 22. Measure outputs of amplifiers U102 and U202 with a scope for $\underline{A+2}$ volt P-P signal centered at zero volts.
Picture on display jitters	Check the vertical size adjustment R109 for wiper noise by turning the wiper briskly while observing the screen. Then readjust for proper screen size. Check for bad solder connections on R109. Repeat the above two steps for horizonal size adjustment R209. Check DAC U201 and U101 for bad solder connections. Check all molex connectors for good connections. Check analog switch U1 for faulty operation, loose connections to socket or poor solder connections.

AUXILLARY CONTROL PCB ASSEMBLY
PL205204

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY
11	T-18R	Ty Wraps		2
12	ref WL205204-1	Wire #1		1
13	ref WL205204-2	Wire #2		1
14	ref WL205204-3	Wire #3		1
		COIN METER ASSEMBLY		
		PL205404		
1		Coin Meter	E2B65D	1
2		Diode	IN4003	1
3		Molex Connector	03-09-2038	1
4		Molex Pins, Fem.	02-09-1118	2
		COIN DOOR ASSEMBLY		
		PL205601		
1	2165	Coin Door		1
2		Lock Assy.		1
3		Coin Mechanisms		2
4		3/16'' x ½'' Carriage Blt. Blk. Ox.		12
5		#10 InternalTooth Lk. Washer		12
6		#10 x 24 Hex Nuts		12
7		½'' Cable Clamps		2
		2081 POWER SUPPLY HARNESS		
		PL205410		
1		Molex Connector Display Board	03-09-2153	1
2		Molex Conn-Logic Bd., Power Supply	03-04-1122	2
3		Molex Connector Audio Board	03-09-1093	1
4		Molex Connector Coin Meter	03-09-1038	1
5		Molex Pins, Female	02-09-1118	23
6		Molex Pins, Male	02-09-2118	15
7		Cable ties	T-18R	20
8		Speaker Term. Lugs		2
9		Molex Conn. Power Supply AC	03-09-1041	1

A/C CORD ASSEMBLY

PL205408

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY
1		Power Cord	54-17238	1
2		#16 Spade Lug	C10-401-P	3
		LOGIC BOARD ASSEMBLY		
		PL205201		
1	37-25LS181	IC, ALU		3
2	37-74LS00	IC, Nand Gate		4
3	37-74LS02	IC, Nor Gate		4
4	37-74LS04	IC, Hex Inverter		3
5	37-74LS08	IC, And Gate		2
6	37-74LS10	IC, Nand Gate		3
7	37-74LS27	IC, Nor Gate		3
8	37-74LS32	IC, Or Gate		4
9	37-74LS75	IC, Quad D Latch		2
10	37-74LS85	IC, Mag, Comparator		3
11	37-74LS86	IC, Exclusive Or		1
12	37-74LS107	IC, Dual J-K Flop		7
13	37-74LS151	IC, 10F8 Multiplier		4
14	37-74LS157	IC, Quad Data Sel.		8
15	37-74LS163	IC, Binary Counter		9
16	37-74LS164	IC, 8 Bit Shift Reg.		1
17	37-74LS194	IC, 4 Bit Shift Reg.		9
18	37-74LS257	IC, Tri-State Quad.		3
19	37-74LS259	IC, 8 Bit Latch		1
20	37-74LS298	IC, Quad Mux		2
21	37-74LS377	IC, Octal D Flop		6
22	37-74LS393	IC, Dual 4 Bit Counter		2
23	37-74S00	IC, Nand Gate		1
24	37-74S02	IC, Nor Gate		1
25	37-74S04	IC, Hex Inverter		2
26	37-74S08	IC, And Gate		1
27	37-74S32	IC, Or Gate		2
28	37-74S113	IC, Dual JK Flop		2
29	37-74S158	IC, Quad Mux.		1
30	37-74S182	IC, Look Ahead Carry		1
31	37-7425	IC, Nor Gate		1
32	37-74265	IC, Output Buffer		1
33	37-2101A2	IC, Ram 256 x 4		3
34	2085	IC, Prom Drom 1		1
35	2086	IC, Prom Drom 2		1
36	2087	IC, Prom Drom 3		1
37	2088	IC, Prom Drom 4		1
38	2089	IC, Prom Drom 5		1
39	2090	IC, Prom Drom 6		1
40	37-74S10	IC, Nand Gate		1

LOGIC BOARD ASSEMBLY
PL205201

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY
41	SW205001	Masked ROM		1
42	SW205002	Masked ROM		1
43		7 Pole Dip. Switch	JS8722-07	1
44		Crystal,20.0 mhz	MP200CTS	1
45		IN914B Diode	IN914B	2
46		Transistor	2N3904	2
47		Transistor	2N6292	1
48		Molex, Conn, 12 Pin	09-18-5127	1
49		Ansley Conn. 16 Pin	609-1622M	1
50		Ansley Conn. 26 Pin	609-2622M	1
51		Ansley Conn. 34 Pin	609-3422	1
52		14 Pin Socket	CA14S10SD	1
53		16 Pin Socket	CA16S10SD	2
54	2076B	Circuit Board		1
55	10-5331	330 1/4w 5% C		2
56	10-5471	470 1/4w 5% C		1
57	10-5102	1 K 1/4w 5% C		12
58	10-5222	2.2K 1/4w 5% C		1
59	10-5103	10K 1/4w 5% C		2
60	10-5303	30K 1/4w 5% C		1
61	10-5564	560K 1/4w 5% C		
62	19-002	1K Res. Dip. Pak	D16-15-2-1K	
63	27-050-024	Cap. .02uf 50V Disc		
64	27-101-681	Cap. 680pf 100V Disc		
65	23-350-330	Cap. 3.3uf 35V Tant.		
66	23-350-331	Cap. 33uf 35V Tant		
67		Test Points	K27C	
68		16 Pin Jumpers	435704-8	
		DISPLAY ASSEMBLY (MONITOR)		
		PL205403		
1	19VARP4	CRT 19''		1
2	SA205405	Heatsink Assy.		1 ref
3	SA205409	Display Sub-Assy.		1 ref
4	LF13331	Analog Switch		1
5	SA205406	Yoke Assembly		1 ref
6	2105B	High Voltage Cage		1
7	171C	Spring		1
8		#10-1/2'' Flat Washer		4
9		#10-1'' Fender Washer		4
10		#10-1/2'' Hex Hd. Sms.		4
11	2136	Label-High Voltage		1
12	2137	Label-Factory Adj. Only		1
13	3064	#6 x 1/2'' Hex Head S.M.S.		11

DISPLAY ASSEMBLY (MONITOR)
PL205403

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY
14	3066	#6 Lock Washer Int.		3
15	3063	6-32 x ½' M.S.		3
16	3065	6-32 Hex Nut		3
17	2169A	Mounting Brkt. LH		1
18	2170A	Mounting Brkt. RH		1
		DISPLAY BOARD ASSEMBLY PL205203		
1	10-5101	Res. 100 ohm ¼w 5% Car.		4
2	10-5102	Res. 1K ¼w 5% Carbon		2
3	10-5103	Res. 10K ¼w 5% Carbon		4
4	10-5150	Res. 15 ohm ¼w 5% Car.		2
5	10-5182	Res. 1.8K ¼w 5% Carbon		1
6	10-5201	Res. 200 ohm ¼w 5% Car.		2
7	10-5222	Res. 2.2K ¼w 5% Carbon		2
8	10-5302	Res. 3K ¼w 5% Carbon		3
9	10-5330	Res. 33 ohm ¼w 5% Car.		2
10	10-5331	Res. 330 ohm ¼w 5% Carbon		1
11	10-5470	Res. 47 ohm ¼w 5% Car.		6
12	10-5471	Res. 470 ohm ¼w 5% Car.		4
13	10-5562	Res. 5.6K ¼w 5% Carbon		3
14	10-5682	Res. 6.8K ¼w 5% Carbon		1
15	10-5821	Res. 820 ohm ¼w 5% Car.		2
16	11-5103	Res. 10K ½w 5% Carbon		2
17	11-5122	Res. 1.2K ½w 5% Carbon		2
18	11-5470	Res. 47 ohm ½w 5% Car.		4
19	11-5475	Res. 4.7M ½w 5% Car.		1
20	11-5822	Res. 8.2K ½w 5% Carbon		4
21	12-5103	Res. 10K 1w 5% Carbon		3
22	12-5270	Res. 2.7 ohm 1w 5% Car.		12
23	12-5361	Res. 360 ohm 1w 5% Car.		2
24		Res. 100 ohm 2w 5% Car.		1
25		Res. 150 ohm 4w 5% Car.		2
26		Res. .18 ohm 3w 5% Car.		4
27		Res. 500 ohm 8w 5% Car.		1
28		Res. 1.43K Metal Film 1%		1
29		Res. 2.1K Metal Film 1%		1
30		Res. 10K Metal Film 1%		2
31	19-311101	Res. 100 ohm Trimpot	3386-P1-101	2
32	19-413502	Res. 5K Trimpot	3386-P-1-502	2
33	31-IN914B	Diode IN914B		10
34	31-IN4003	Diode IN4003		36
35	31-MR818	Diode MR818 Fast Rec.		2
36	31-MR250-2	Diode, Fast Recovery MR-250-2		1

DISPLAY BOARD ASSEMBLY
PL205203

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY
37	37-7406	I.C. Hex Inverter O.C.		1
38	37-7815	I.C. +15V Regulator		1
39	37-7818	I.C. +18V Regulator		1
40	37-7915	I.C. -15V Regulator		1
41	37-7918	I.C. -18V Regulator		1
42	37-TL081	I.C. TL081 OP Amp.		2
43	37-DAC80	Digital to Analog Conv.		2
44	33-2N2102	Transistor		4
45	33-2N3904	Transistor		3
46	33-2N3906	Transistor		2
47	33-2N5210	Transistor		7
48	33-2N5320	Transistor		2
49	33-2N5322	Transistor		4
50	33-2N5550	Transistor		1
51	33-T1P41C	Transistor		1
52	41-3006	Choke 100MH 2A	Miller 5250	1
53	03-09-1152	Connector Housing	Molex	1
54	02-09-2134	Pins Male Solder Tail	Molex	8
55	09-18-5061	Connector Molex Wafercon	Molex	2
56	609-3422-M	Connector 34 Pin	Ansley	1
57	2071E	Etch Board		1
58	23-350-024	Cap. .02 35V		1
59	23-350-104	Cap. .1 35V		1
60	23-350-470	Cap. 4.7 35V		1
61	23-350-220	Cap. 2.2 35V Tant		4
62	24-101-106	Cap. 10 MFD 100V Axial		1
63	24-101-505	Cap. 5MFD 100V Axial		1
64	24-151-106	Cap. 10MFD 150V Axial		1
65	24-500-476	Cap. 47MFD 50V		5
66	24-500-506	Cap. 50MFD 50V		1
67	24-601-104	Cap. .1MFD 600V		1
68	27-050-104	Cap. .1MFD Disc 50V		2
69	27-050-474	Cap. .47MFD 50V		2
70	27-050-503	Cap. .005MFD Disc.		2
71	29-024-224	Cap. .022MFD 200V		2
72		Cap. .1MFD 100V		7
73	CA16S10SD	16 Pin Socket		1
74	37-7805	I.C. 7805 +5V		1
		YOKE ASSEMBLY PL205406		
1	746	Yoke, Broy		1
2	03-09-1063	Molex Connector		1
3	02-09-1118	Molex Pins-Female		3
4	02-09-2118	Molex Pins-Male		1

MONITOR HEATSINK ASSEMBLY
PL205405

ITEM	PART NUMBER	DESCRIPTION	REF. DES.	MFGR. PART NO.	QTY
1	2107-A	Heat Sink			2
2		Transistor		2N5876	2
3		Transistor		2N5878	2
4		Washers Greaseless			4
5	2179	Heatsink Harness, Long			1
6	2178	Heatsink Harness, Short			1
7	2134	Label"Warning"			1
8		6-32 X ½" M.S., P.H.D.		3062	8
		DISPLAY SUB-ASSEMBLY PL205409			
1	2084D	Chassis			1
2	AE205203	Display BD. Assembly			1 ref
3	3064	#6 X ½" Sheet Metal Screw			6
4	HV18	Hi Voltage XFMR T1			1
5	MH919TOL	Varo Trippler A1			1
6	JAIN056103UA	10K Pot Allen Bradley R13			1
7	22030B	Heatsink-Thermalloy			6
8	6045-B4	Heatsink-Thermalloy			3
9		CRT Socket			1
10	3083	8-32 X ½ Ms. Phil. HD			2
11	3084	8-32 Nuts			2
12	3085	#8 Lock Washer			2
13		.05mf @1500VDC, Cap.			2
14		Wire 9", 18 Gage			2
15		Lug, Gnd.			1
16		#6 X ½ Sheetmetal Sc.			1
17		3/16"Diam 3" Heatshrink Tubing			2
18		3/16" Diam 2" Heatshrink Tubing			2
19	AD205411	(Audio to Display Harness)			1 ref
20	NE2	Neon Bulb			2
		AUDIO BOARD-TAILGUNNER PL205202			
1		Diode-Zener	D1	IN5240	1
2		Diode-IN914	D2, 3, 4, 5, 6, 7, D 8, 9 D10, 11	IN914	10
3		Cap. 470pf 50V Disc.	C34, 35, 36		3
4		Cap. .002uf 50V Disc.	C17		1
5		Cap. .005uf 50V Disc.	C11, 41		2
6		Cap. .01uf 50V Disc.	C3, 18, 19 C20, 23, 30		6

AUDIO BOARD-TAILGUNNER
PL205202

ITEM	PART NUMBER	DESCRIPTION	REF. DES.	MFGR. PART NO.	QTY
7		Cap. .05uf 50V Disc.	C14, 31		2
8		Cap. .1uf 50V Disc.	C2, 4, 7, 9, 10, C12,13, 21, 22 C27, 32, 33, C42, C 49, 50 & C51		16
9		Cap. .22uf .35V Tant.	C25		1
10		Cap. .47 35V Tant.	C28 & 29		2
11		Cap. .68 35V Tant.	C6		1
12		Cap. 1uf 35V Tant	C8		1
13		Cap. 2.2uf 35V Tant	C44		1
14		Cap. 3.3uf 35V Tant	C45, 46, 47, 48		4
15		Cap. 4.7uf 35V Tant.	C26		1
16		Cap. 10uf 35V Tant.	C15, 16, 43		3
17		Cap. 15uf 35V Tant.	C24		1
18		Cap. 33uf 35V Tant.	C46, 47, 48, 49		4
19		Cap. 100uf 25V Elect.	C1, C5		2
20		Res. 100 OHMS 1/4W 5% C	R5		1
21		Res. 150 OHMS 1/4W 5% C	R29, 71, 73		3
22		Res. 330 OHMS 1/4W 5% C	R41, 42, 46		3
23		Res. 470 OHMS 1/4W 5% C	R3, 70		2
24		Res. 1K 1/4W 5% Carbon	R10, 16, 22, 34, R 45, 60, 81, 88, R 92, 93		10
25		Res. 2K 1/4W 5% Carbon	R58		1
26		Res. 2.7K 1/4W 5% Carbon	R21, 27, 28 R48, 49, 78, 79		7
27		Res. 4.7K 1/4W 5% Carbon	R54, 57, 61, 94		4
28		Res. 9.1K 1/4W 5% Carb.	R12		1
29		Res. 10K 1/4W 5% Carbon	R6, 8, 15, 17,23, R 26, 30, 33, 35, R 59, 64, 67, 83, R 87, 91		15
30		Res. 15K 1/4W 5% Carbon	R66		1
31		Res. 20K 1/4W 5% Carbon	R14, 18, 32 R36, 62, 65,68		7
32		Res. 22K 1/4W 5% Carbon	R22		1
33		Res. 30K 1/4W 5% Carbon	R44, 69		2
34		Res. 39K 1/4W 5% Carbon	R19, 37		2
35		Res. 47K 1/4W 5% Carbon	R9, 24, 74, 76, R 77, 85, 89		7
36		Res. 68K 1/4W 5% Carbon	R40		1
37		Res. 82K 1/4W 5% Carbon	R20, 38		2
38		Res. 91K 1/4W 5% Carbon	R84		1
39		Res. 100K 1/4W 5% Carbon	R39, 80		2
40		Res. 150K 1/4W 5% Carbon	R53		1
41		Res. 180K 1/4W 5% Carbon	R63		1
42		Res. 220K 1/4W 5% Carbon	R47		1
43		Res. 330K 1/4W 5% Carbon	R11, 25, 52, 82		4

AUDIO BOARD-TAILGUNNER
PL205202

ITEM	PART NUMBER	DESCRIPTION	REF. DES.	MFGR. PART NO.	QTY.
44		Res. 360K ¼W 5% Carbon	R51		1
50		Res. 390K ¼W 5% Carbon	R55		1
51		Res. 470K ¼W 5% C	R2, 4,		2
52		Res. 560K ¼W 5% C	R43		1
53		Res. 820K ¼W 5% C	R50		1
54		Res. 910k 4w 5% C	R56		1
55		Res. 1M ¼W 5% C	R1,7,13,31		4
56		Res. 100K Pot	R75, 86, 90		3
57		Trans. 2N3904 NPN	Q1,2,9, 10		4
58		Trans. 2N3906 PNP	Q3,4,5,8		4
59		Trans. 2N6292 NPN	Q6		1
60		Trans. 2N6107 PNP	Q7		1
61		I.C. TL081	IC 1,2,3,7,9,11, 19,24,25,26,27		11
62	74LS125	I.C. LS125	IC4		1
63		I.C. 7404	IC5		1
64		I.C. 7406	IC6,28		2
65		I.C. LS393	IC8,18		3
66		I.C. CA3080	IC10,13,22		1
67	74LS123	I.C. LS123	IC12		3
68	LM555	I.C. 555	IC 14,15,16,17		1
69		IC. 7915	IC20		1
70		IC. 7815	IC21		1
71		IC. LS259	IC23		1
72	6071B	Heatsink-Thermalloy			2
73	6072B	Heatsink-Thermalloy			2
74	09-18-5094	Conn. Molex 9 Pin	J1, J3		2
75	09-18-5069	Conn. Molex 6 Pin	J2		1
76	609-1622M	Conn. Ansley 16 Pin	J4		1
77		4-40 X ½ Ms. Rhl. Hd.			4
78		#4 Lock Wshr. Internal			4
79		4-40 Hex Nut			4
80	AW205202	Circuit Board			1
81	CA-165-105D	16 Pin Socket-Solder Tail			1
82	09-18-5062	Conn. Molex 6 Pin	J5		1
		2708 PROM BOARD ASSEMBLY (KLUDGE TO CPU) 38-10522-01			
1		Heatsink	11SU5, HSU6	6072B	2
2		Heatsink	11SU5, HSU6	6071B	2
3		4-40 Hex Nut			6
4		4-40 Mach. Screw 3/8'' Phil. Panhead			6
5		Test Points			2

2708 PROM BOARD ASSEMBLY
(KLUDGE TO CPU)
38-10522-01

ITEM	PART NUMBER	DESCRIPTION	REF. DES.	MFGR. PART NO.	QTY
6		24 Pin Dip Socket	U1-U8		8
7		+12V Voltage Reg.	U10	7812	1
8		-5V Voltage Reg.	U11	7905	1
9		2 Line to 4 Line Decod.		74LS139	1
10		3.3uf Tant. Cap. 35V			4
11		.02uf Cap. Disc. 50V			7
12		PC Board		80-10518A	1
13		24 Pin Dip Cable		CA-D24P-02-261-CC-10	2
14		Game Proms	205A-1 Thru 205D-2	2708	8
15		¼'' Swag Spacer #6 Through Hole for .090 BD.		1533-C-6-B-1 Mfr. Raf.	2
16		4-40 X ½'' Phil. Pan Head Screw			2
17		#4 Hex Nut			2
18	MP203611	Mounting Brkt.			1
19	03-09-1063	6 Pin Molex Male			1
20	02-09-1118	Molex Pins Female			2
21	02-09-2118	Molex Pins Male			1
	ref.				
22	WL38-10522-01	Wire #1			1
	ref.				
23	WL38-10522-01	Wire #2			1
	ref.				
24	WL38-10522-01	Wire #3			1
25	T-18R	Ty Wrap			1

JOYSTICK ASSEMBLY
PL205413

1	900-098	Joystick			1
2	09-50-3031	Molex 3 Pin Female			1
3	08-50-0126	Female Molex Crimp Terminal			2
4	03-09-1063	Molex 6 Pin Male			1
5	02-09-1118	Molex Pins Female			5
6	ref. WL205413-1	Wire #1			2
7	ref. WL205413-2	Wire #2			1
8	ref. WL205413-3	Wire #3			1
9	ref. WL205413-4	Wire #4			1
10	ref. WL205413-5	Wire #5			1
11	ref. WL205413-6	Wire #6			1
12	ref. WL205413-7	Wire #7			1
13	ref. WL205413-8	Wire #8			1
14		Ty Wrap		T18R	7

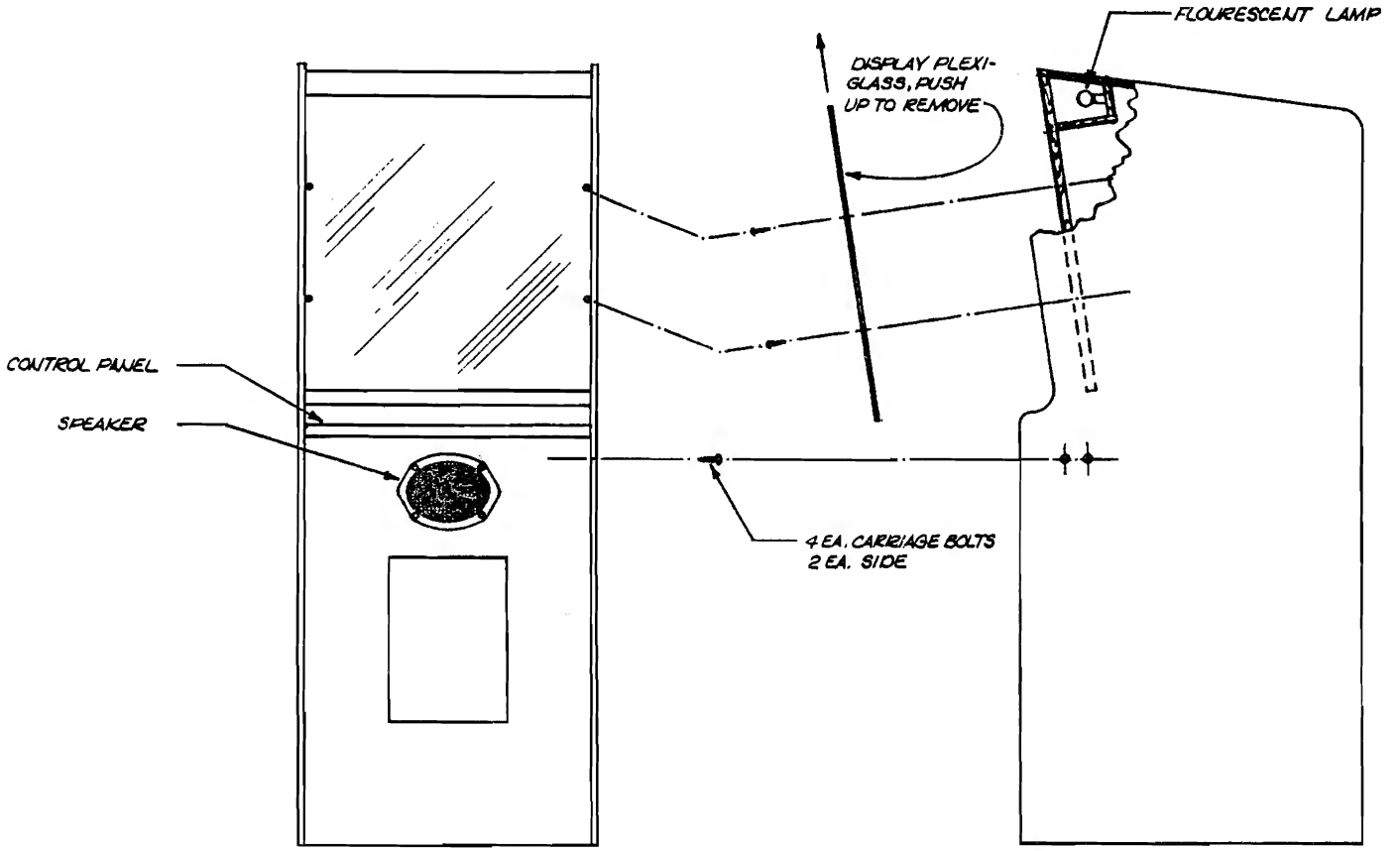
AUDIO TO JOYSTICK
WIRE HARNESS ASSEMBLY
PL205412

ITEM	PART NUMBER	DESCRIPTION	MFGR. PART NO.	QTY.
1	09-18-5094	Molex Conn. Female 9 Pin		1
2		Molex Conn. Female 6 Pin		1
3	02-09-1118	Molex Pins Female		4
4	02-09-2118	Molex Pins Male		6
5	T-18R	Ty Wraps		5
6	ref. WL205412-1	Wire #1		1
7	ref. WL205412-2	Wire #2		1
8	ref. WL205412-3	Wire #3		1
9	ref. WL205412-4	Wire #4		1
10	ref. WL205412-5	Wire #5		1
		AUDIO TO DISPLAY HARNESS PL205411		
1	03-09-1063	Molex Conn. 6 Pin		1
2	02-09-1118	Molex Pins Female		4
3	ref. WL205411-1	Wire #1		1
4	ref. WL205411-2	Wire #2		1
5	ref. WL205411-3	Wire #3		1
6	ref. WL205411-4	Wire #4		1
7	T-18R	Ty Wraps		3

APPENDIX A

Assembly Drawings,
Schematics & Wiring Diagrams

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

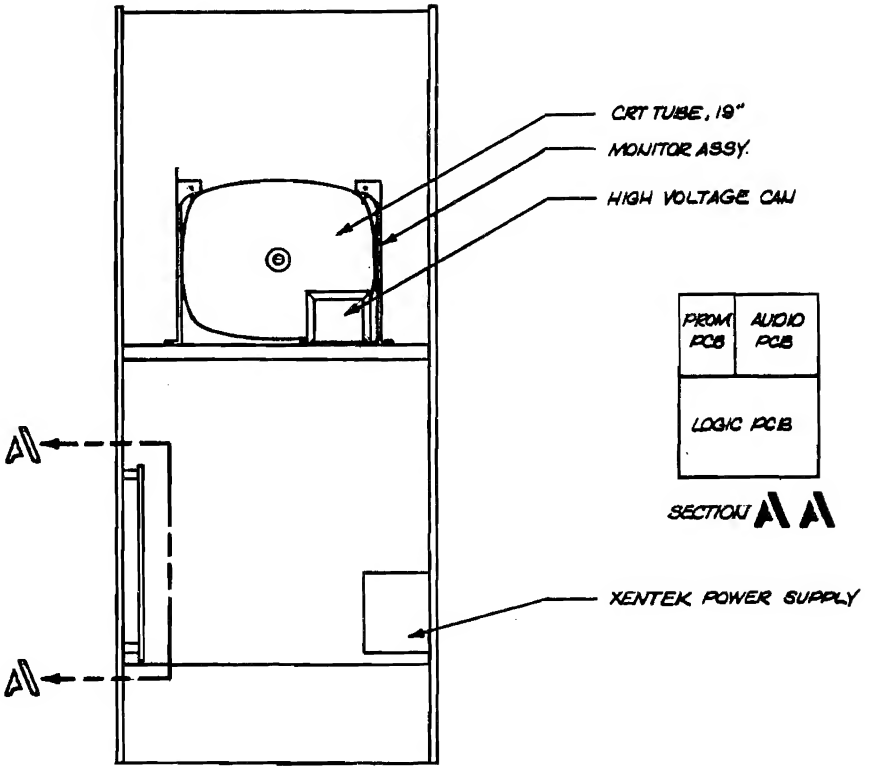


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: Arthur Davis	DATE 9/24/79	CINEMATRONICS INC. El Cajon Ca. 92020
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	PROJECT ENGR: C. Williams	DATE 9-79	DWG TITLE: FRONT CABINET ASSY. ILLUSTRATION
	RELEASE APPROV: C.E.W.	DATE 9-79	
	DO NOT SCALE DWG		MODEL NO. / DWG SIZE / DWG NO. MN209801 / REV R
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		CODE IDENT. / SHEET 1 OF 1
	PROJECTION:	SCALE:	

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVI

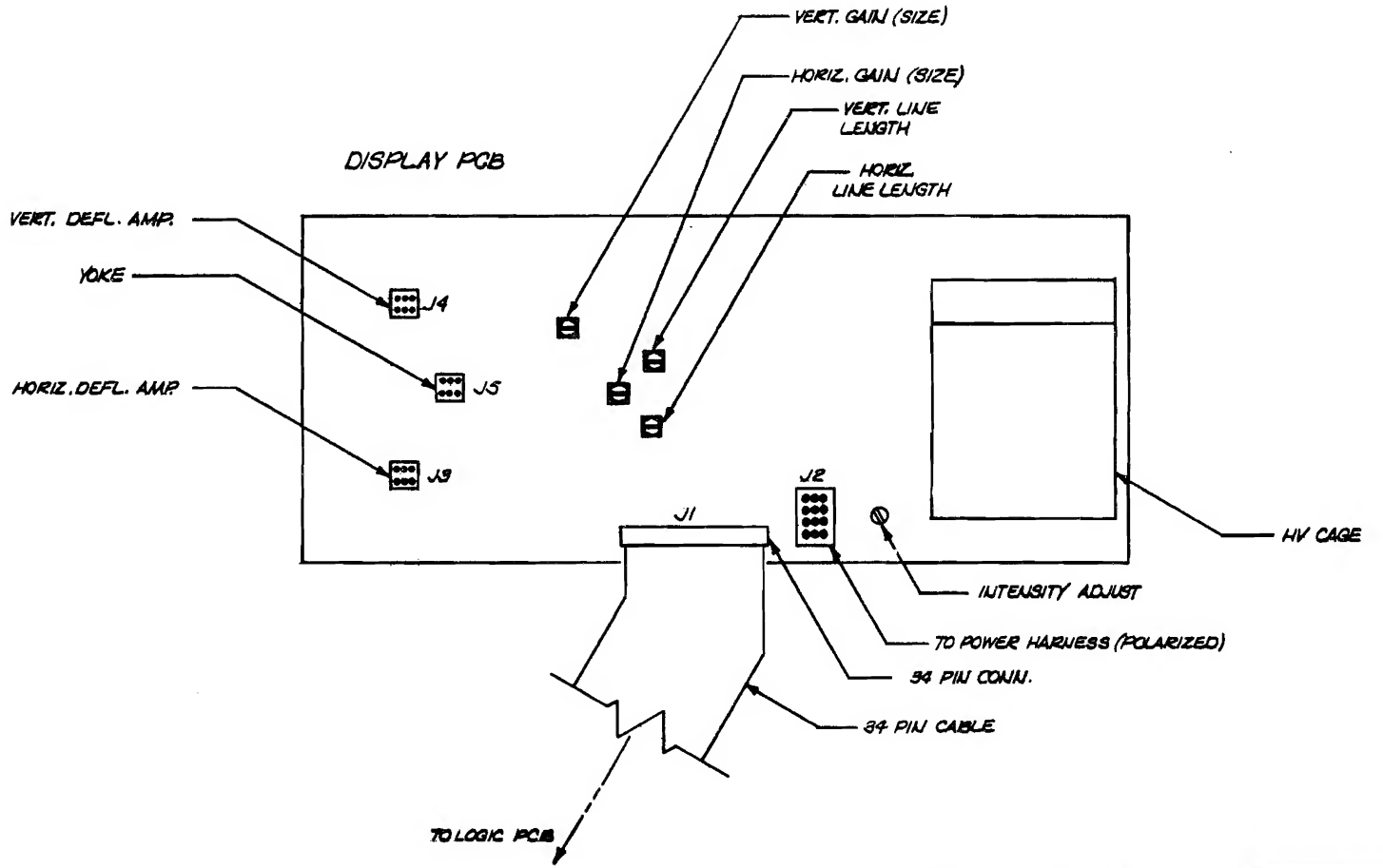


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: O. Thacker	DATE 10-79	CINEMATRONICS INC. El Cajo Ca. 92020
	PROJECT ENGR: C. Williams	DATE 10-79	DWG TITLE: REAR CABINET ASSY. ILLUSTRATION
	RELEASE APPROV: CEW	DATE 10-79	
FINISH:	DO NOT SCALE DWG		MODEL NO. / DWG SIZE C / DWG NO. MV8058O1 / REV A
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		
	PROJECTION:	SCALE: 1/2 SIZE	CODE IDENT. / SHEET 1 OF 1

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

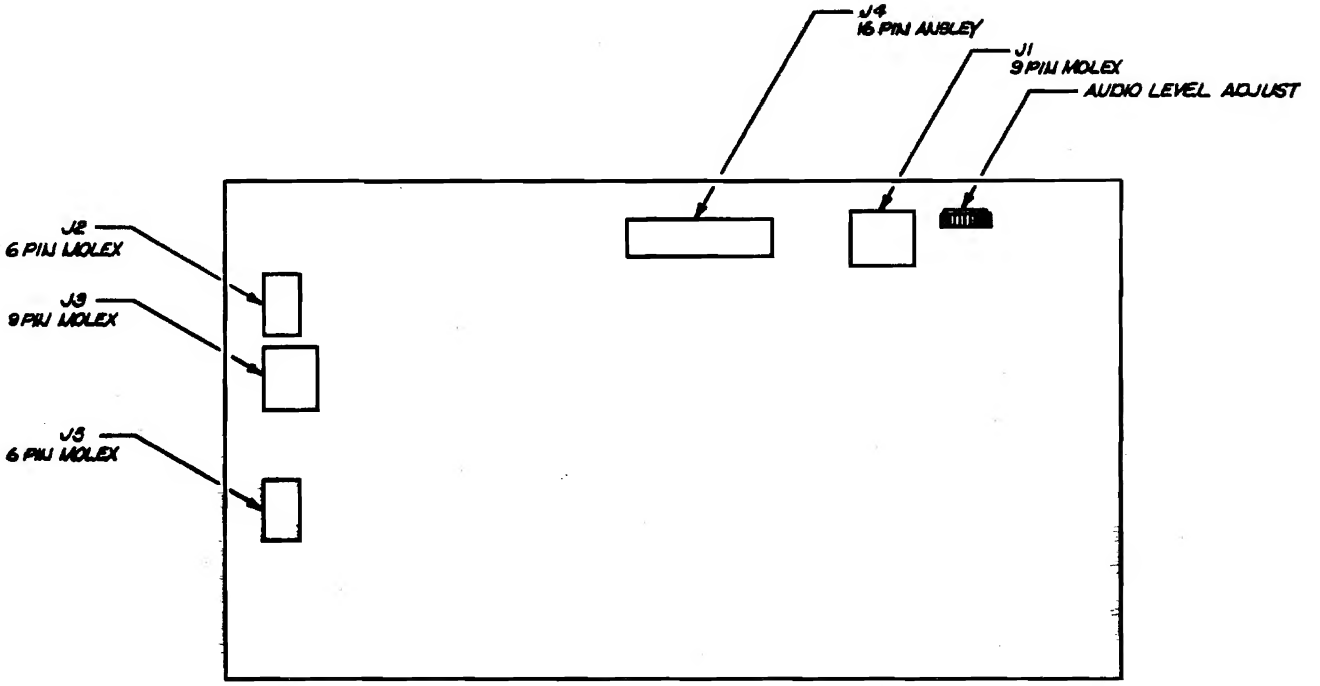


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: A. Macau	DATE 9-24-79	CINEMATRONICS INC. El Cajon, Ca. 92020
	PROJECT ENGR: C. Williams	DATE 9-79	
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	RELEASE APPROV: C. Eun	DATE 9-79	DWG TITLE: MONITOR BOARD ILLUSTRATION
	DO NOT SCALE DWG.		
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		MODEL NO. / DWG SIZE / DWG NO. MN203804 / REV F
	PROJECTION:	SCALE:	CODE IDENT. / SHEET / OF /

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVE

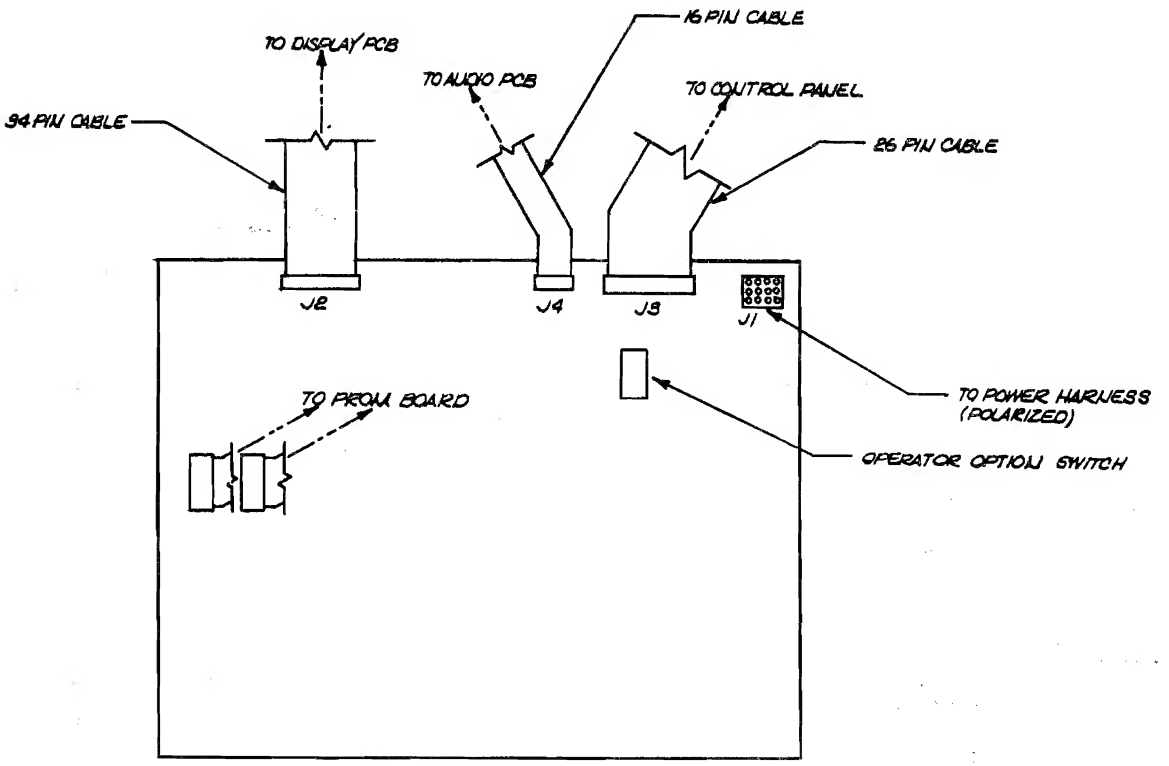


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: C. Thomas	DATE 10-79	CINEMATRONICS INC. El Cajon, Ca. 92020
	PROJECT ENGR: C. Williams	DATE 10-79	DWG TITLE: AUDIO BOARD ILLUSTRATION
	RELEASE APPROV: CEW	DATE 10-79	
FINISH:	DO NOT SCALE DWG		
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		MODEL NO. / DWG SIZE C / DWG NO. MVE05802 / REV A
	PROJECTION:	SCALE: 1:1	CODE IDENT. / SHEET 1 OF 1

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

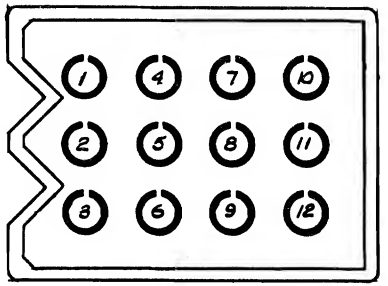


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: A. Thacker DATE 9-24-79	CINEMATRONICS INC.	El Cajon Ca. 92020
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	PROJECT ENGR: C. Williams DATE 9-29	DWG TITLE: C.P.U. BOARD ILLUSTRATION	
	RELEASE APPROV: C.E.W. DATE 9-29		
	DO NOT SCALE DWG		
	TOLERANCE: UNLESS OTHERWISE SPECIFIED	MODEL NO. / DWG SIZE / DWG NO. 710-0209-03 / REV F	
	PROJECTION: SCALE:	CODE IDENT. / SHEET 1 OF 1	

4 3 2 1

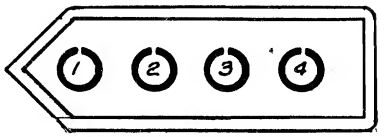
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



J1

	J1 CONNECTOR DATA		
	PIN NO.	WIRE COLOR	FUNCTION
	J1-1	GRN/YEL	CHASSIS GND
	J1-2	WHT	TXFMR LUG #3
1	J1-3	BLK	TXFMR LUG #1
	J1-4	GRN/YEL	6.3VAC GND
	J1-5	ORG	6.3VAC
2	J1-6	BRN	SPOT KILL (25UNF)
3	J1-7	YEL	+25V
4	J1-8	BLU	-25V
	J1-9	RED	+5V
	J1-10	GRY	+5V
	J1-11	BLK	+5V RETURN
	J1-12	RED	± 25V RETURN

1. 3AMP INLINE FUSE.
2. .3AMP INLINE FUSE.
3. 3AMP INLINE CIRCUIT BREAKER CB1.
4. 3AMP INLINE CIRCUIT BREAKER CB2.



J2

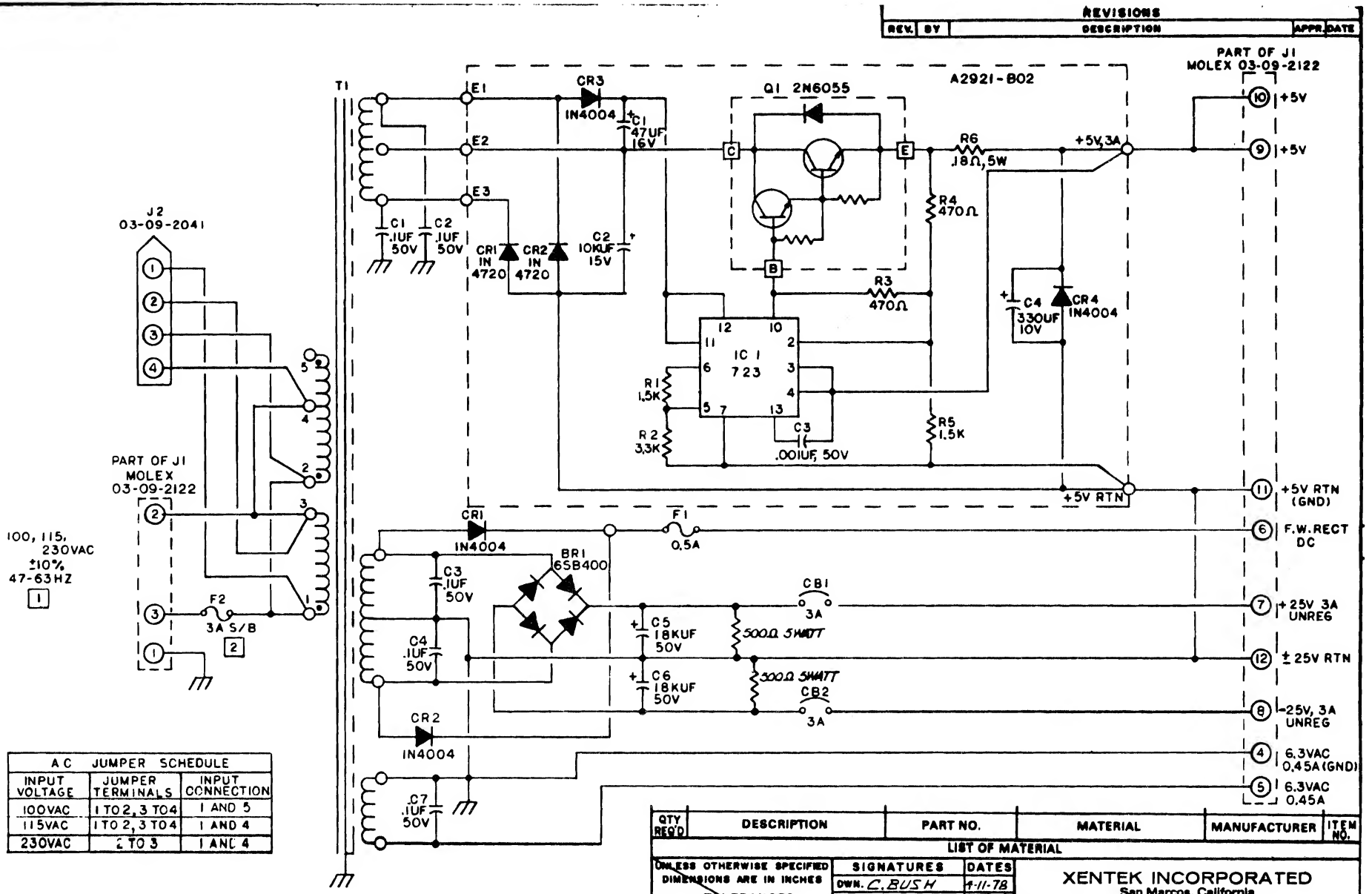
	J2 CONNECTOR DATA	
PIN NO.	WIRE COLOR	FUNCTION
J2-1	BRN	TXFMR LUG #1
J2-2	ORG	TXFMR LUG #3
J2-3	RED	TXFMR LUG #2
J2-4	YEL	TXFMR LUG #4

XENTEK POWER SUPPLY
BOTH J1 & J2 AS VIEWED FROM THE FRONT OF POWER SUPPLY.

NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: A. Macias	DATE 3-79	CINEMATRONICS INC. El Cajon Ca. 92020
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	PROJECT ENGR: C. Williams	DATE 9-79	DWG TITLE: POWER SUPPLY PINOUT ILLUSTRATION
	RELEASE APPROV: CEW	DATE 9-79	
	DO NOT SCALE DWG		MODEL NO. / DWG SIZE / DWG NO. MN209807 / REV A
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		
	PROJECTION:	SCALE:	CODE IDENT. / SHEET / OF /

4 | 3 | 2 | 1



A C JUMPER SCHEDULE		
INPUT VOLTAGE	JUMPER TERMINALS	INPUT CONNECTION
100VAC	1 TO 2, 3 TO 4	1 AND 5
115VAC	1 TO 2, 3 TO 4	1 AND 4
230VAC	2 TO 3	1 AND 4

[2] RECOMMENDED FUSING; 3A SLO BLO FOR 115V.
1.5A SLO BLO FOR 230V

[1] TRANSFORMER SHOWN WIRED FOR 115VAC OPERATION

NOTES:

QTY REQ'D	DESCRIPTION	PART NO.	MATERIAL	MANUFACTURER	ITEM NO.

LIST OF MATERIAL

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
FRAC. ±1/32 DEC. .XX ±.02 .XXX ±.010 ANGLES ±1/2°
MATERIAL:
FINISH:

SIGNATURES	DATES
DWN. C. BUSH	4-11-78
CHK.	
DSGN. M. DEICHER	4/15/78
ENGR.	
APPR.	4/15/78

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DO NOT SCALE DWG.

XENTEK INCORPORATED
San Marcos, California

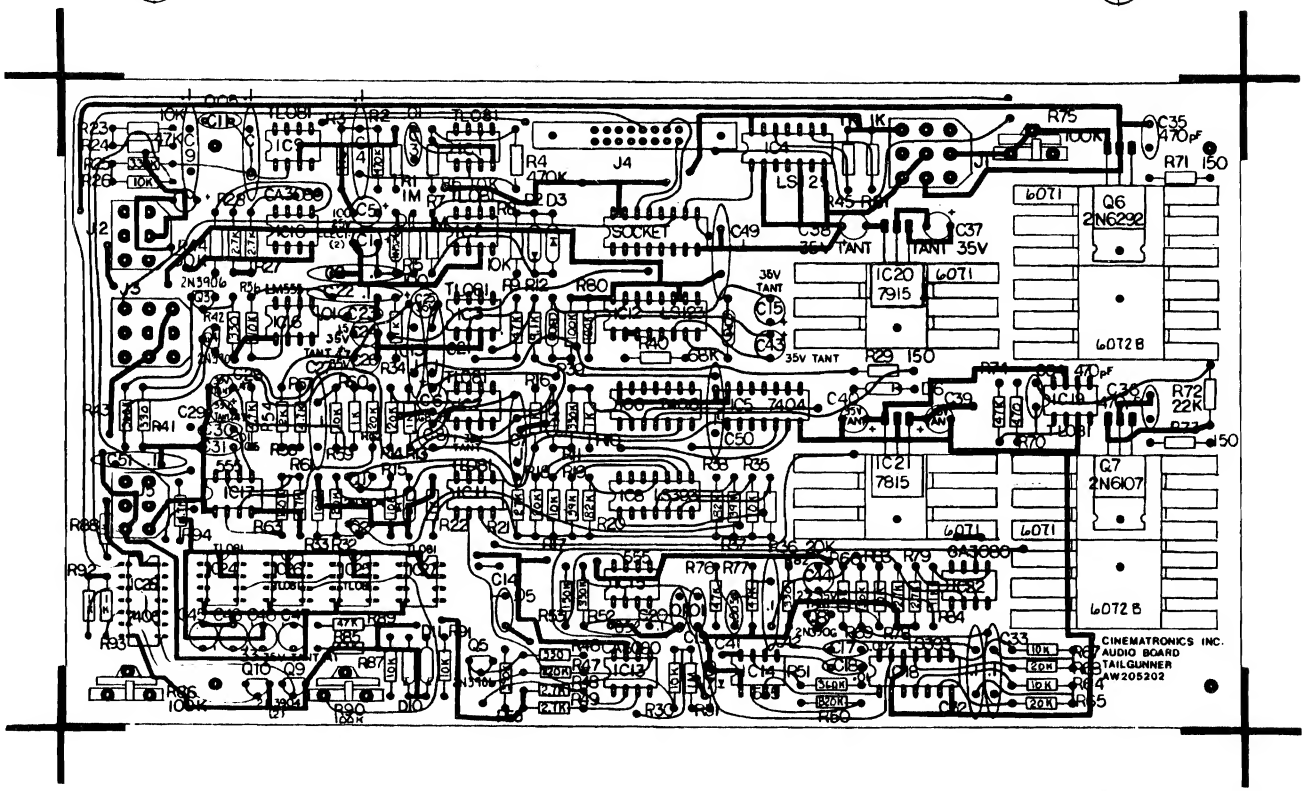
TITLE
SCHEMATIC, POWER SUPPLY
CINEMATRONICS

CODE IDENT	SIZE	DWG. NO.	REV.
53279	C	C2921-S01	A

SCALE: WEIGHT: SHEET 1 OF 1

REVISIONS

REV	DESCRIPTION	DATE	APPROV

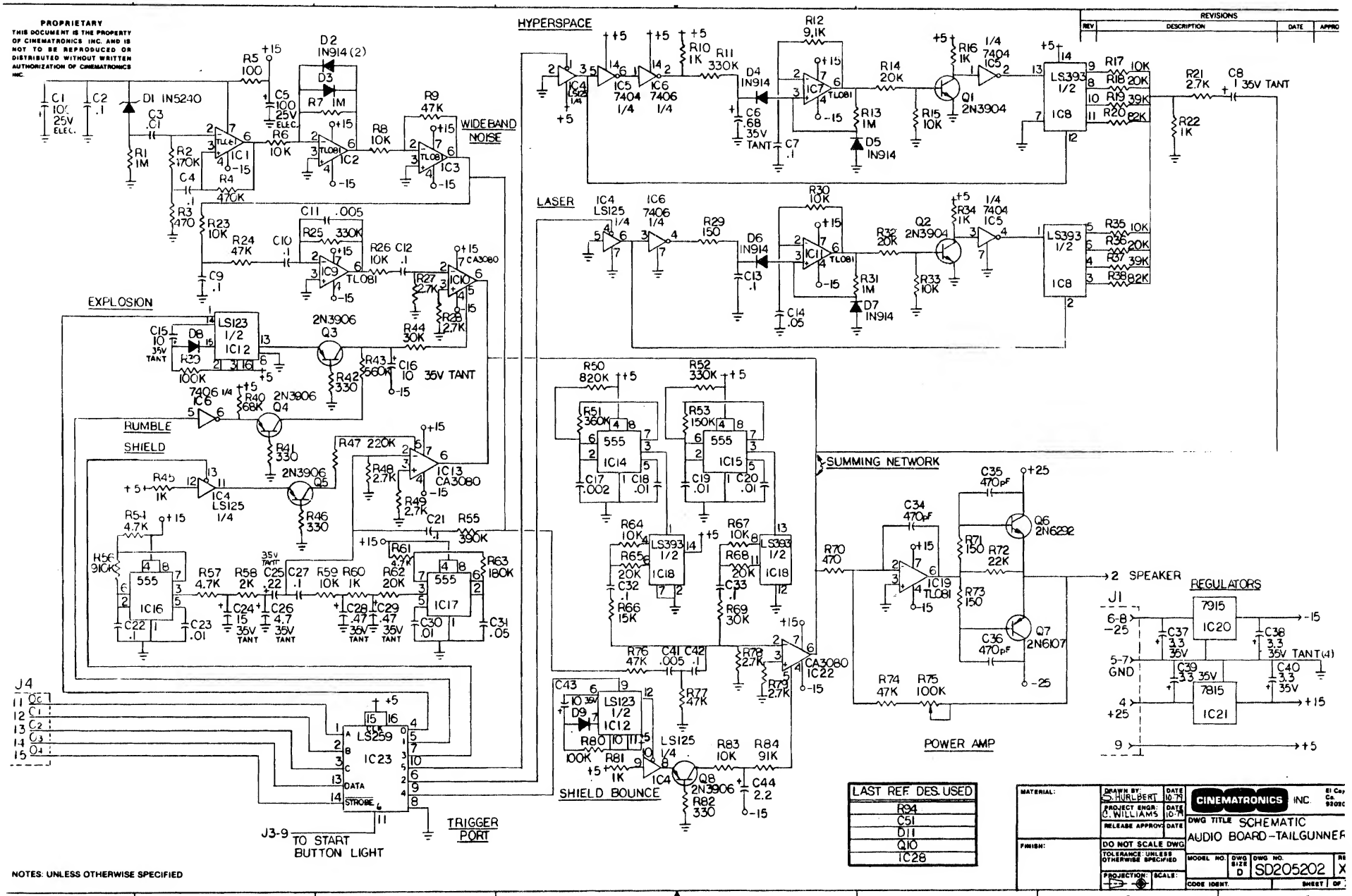


NOTES UNLESS OTHERWISE SPECIFIED

1. C49, C50, C51 & C52 ARE BYPASS CAPS.
2. ALL DIODES ARE IN914 UNLESS OTHERWISE SPECIFIED.
3. ALL CAPACITOR VALUES ARE IN MICROFARADS, 50V, UNLESS OTHERWISE SPECIFIED.
4. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5% UNLESS OTHERWISE SPECIFIED.

MATERIAL	DRAWN BY S.MURLBERT	DATE 10-79	CINEMATRONICS INC	
	PROJECT ENGR C.WILLIAMS	DATE 10-79	DWG TITLE AUDIO BOARD ASSY - TAILGUNNER	
	RELEASE APPROV	DATE		
FINISH:	DO NOT SCALE DWG		MODEL NO	DWG SIZE D / DWG NO AE205202
	TOLERANCE UNLESS OTHERWISE SPECIFIED		CODE IDENT	SHEET 1 OF
	PROJECTION	SCALE 2:1		

8 | 7 | 6 | 5 | 4 | 3 | 2 | 1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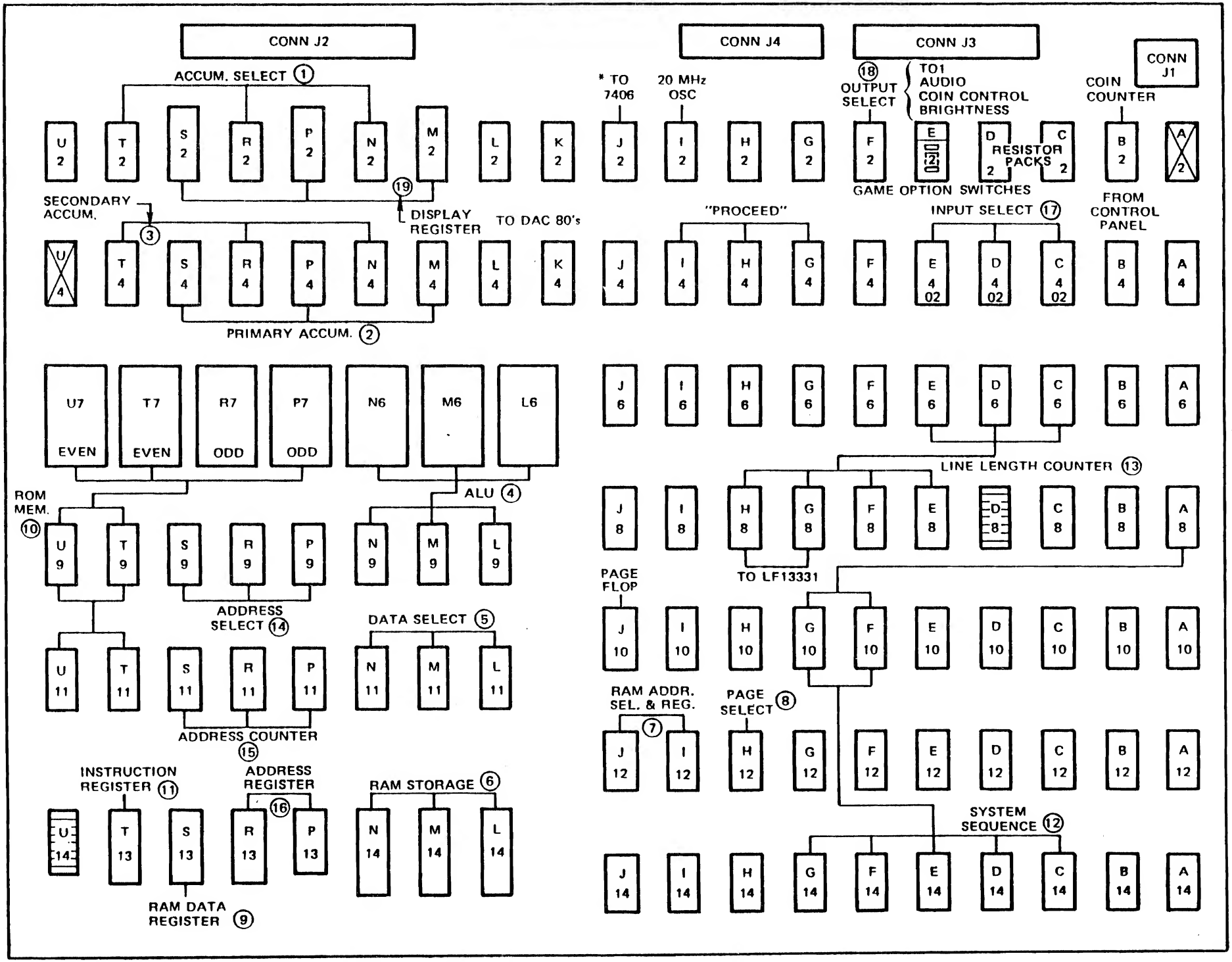
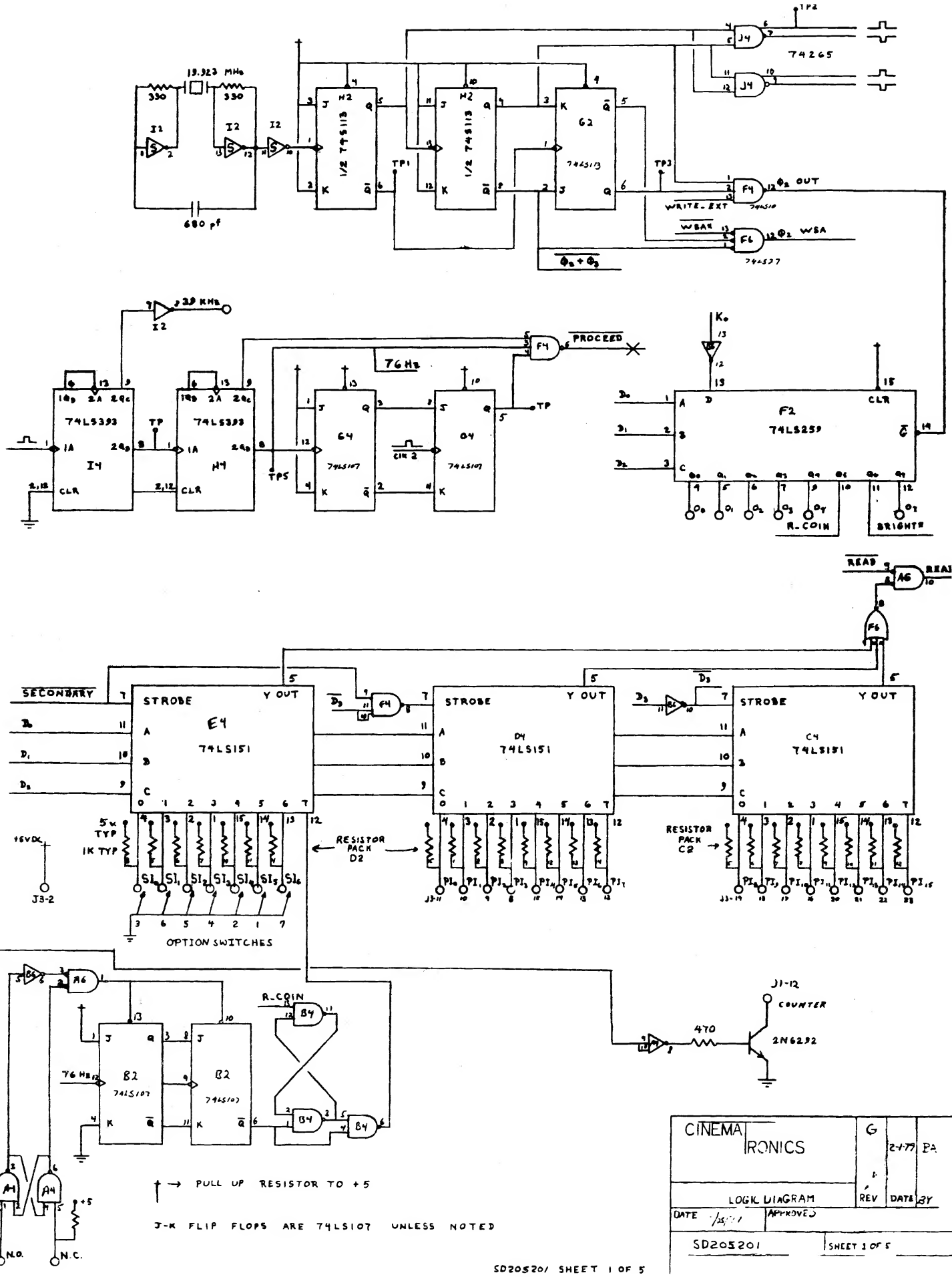
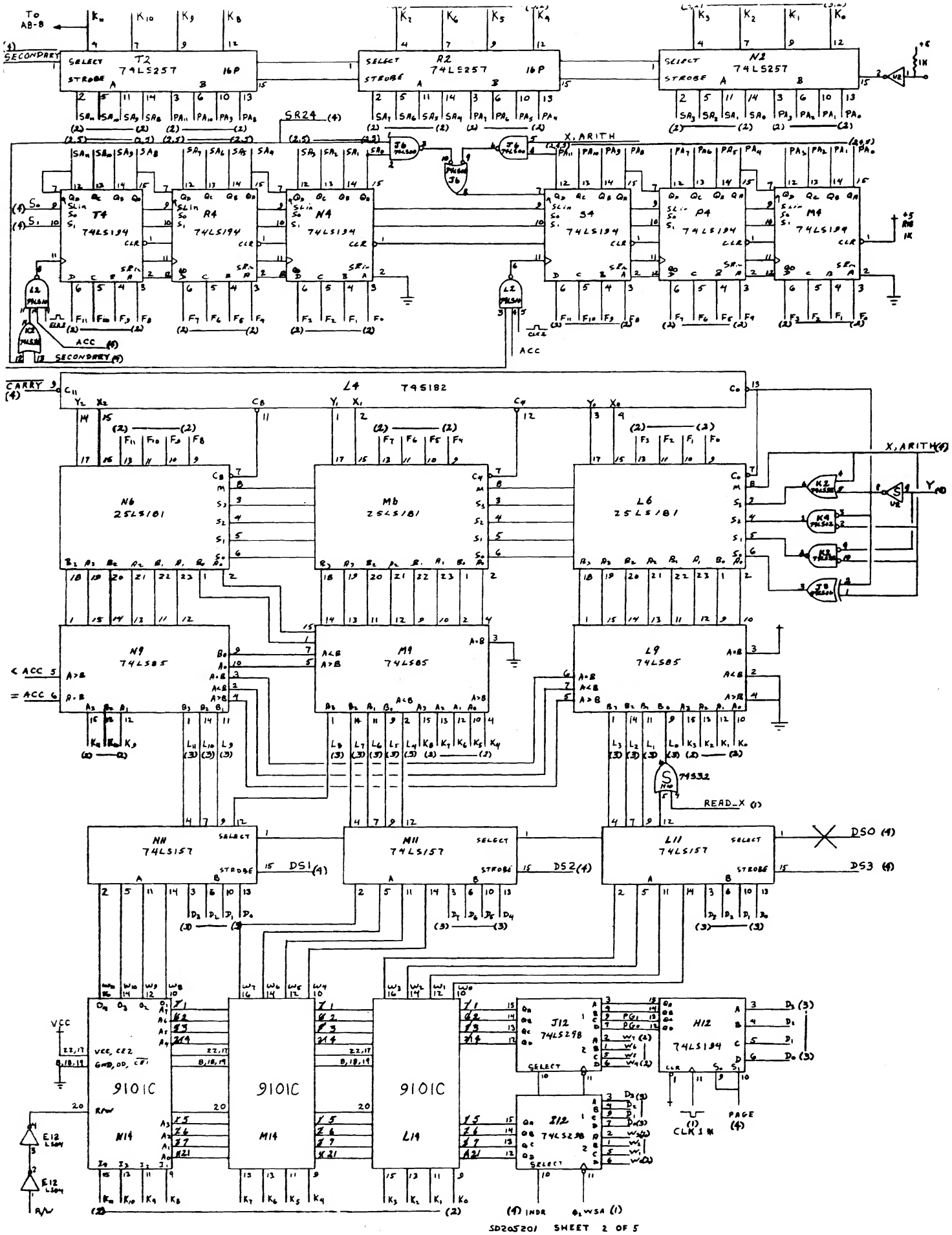
REVISIONS
REV
DESCRIPTION
DATE
APPRO
HYPERSPACE
LASER
EXPLOSION
RUMBLE
SHIELD
WIDEBAND NOISE
SHIELD BOUNCE
SUMMING NETWORK
POWER AMP
REGULATORS
2 SPEAKER
J1
J4
J3-9 TO START BUTTON LIGHT
TRIGGER PORT
LAST REF. DES. USED
R94
C51
D11
Q10
IC28
CINEMATRONICS INC.
DWG TITLE SCHEMATIC
AUDIO BOARD-TAILGUNNER
DRAWN BY: J. HURLBERT
PROJECT ENGR: C. WILLIAMS
RELEASE APPROV:
DO NOT SCALE DWG.
TOLERANCE: UNLESS OTHERWISE SPECIFIED
MODEL NO.
DWG SIZE D
DWG NO. SD205202
CODE IDENT.
SHEET
NOTES: UNLESS OTHERWISE SPECIFIED

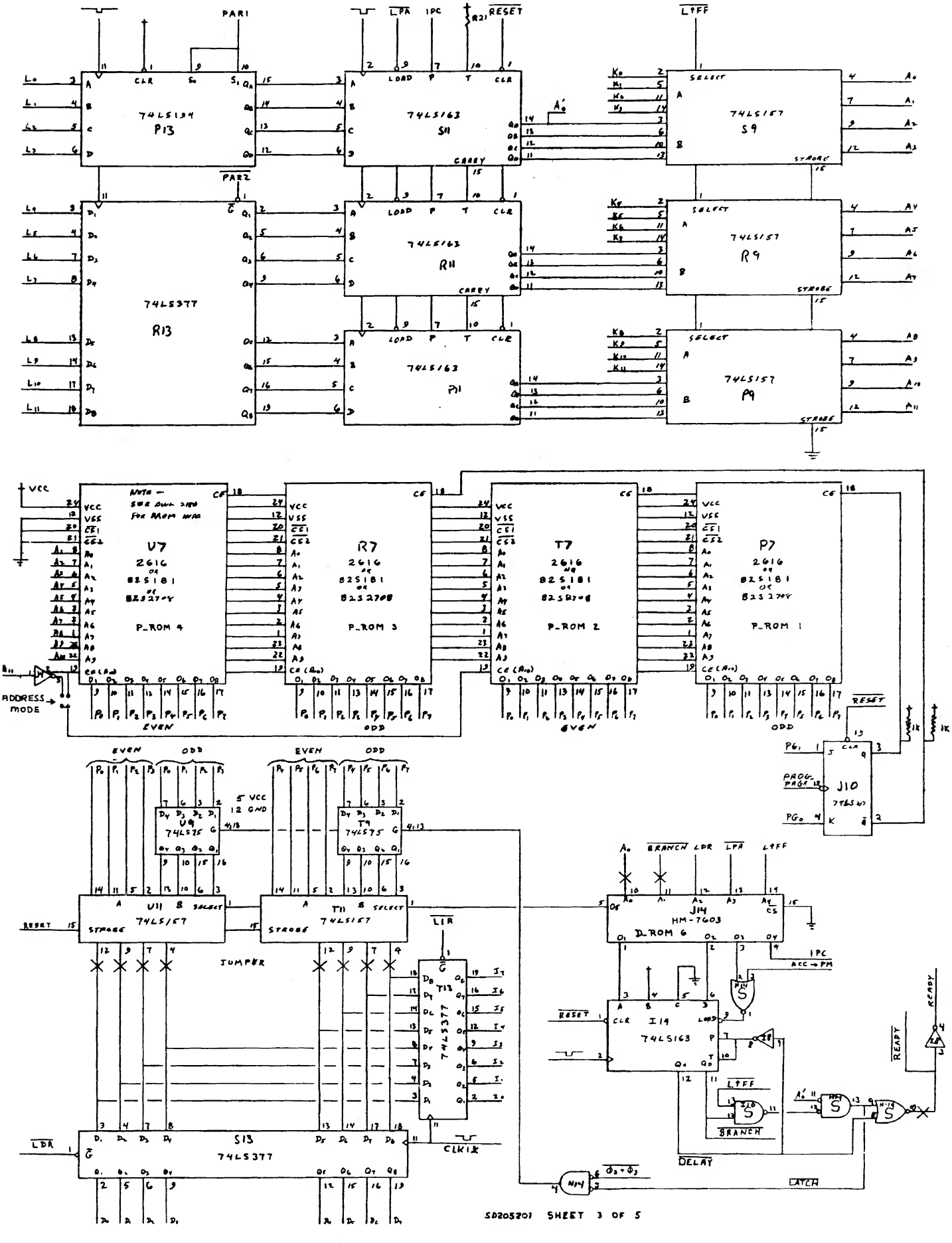


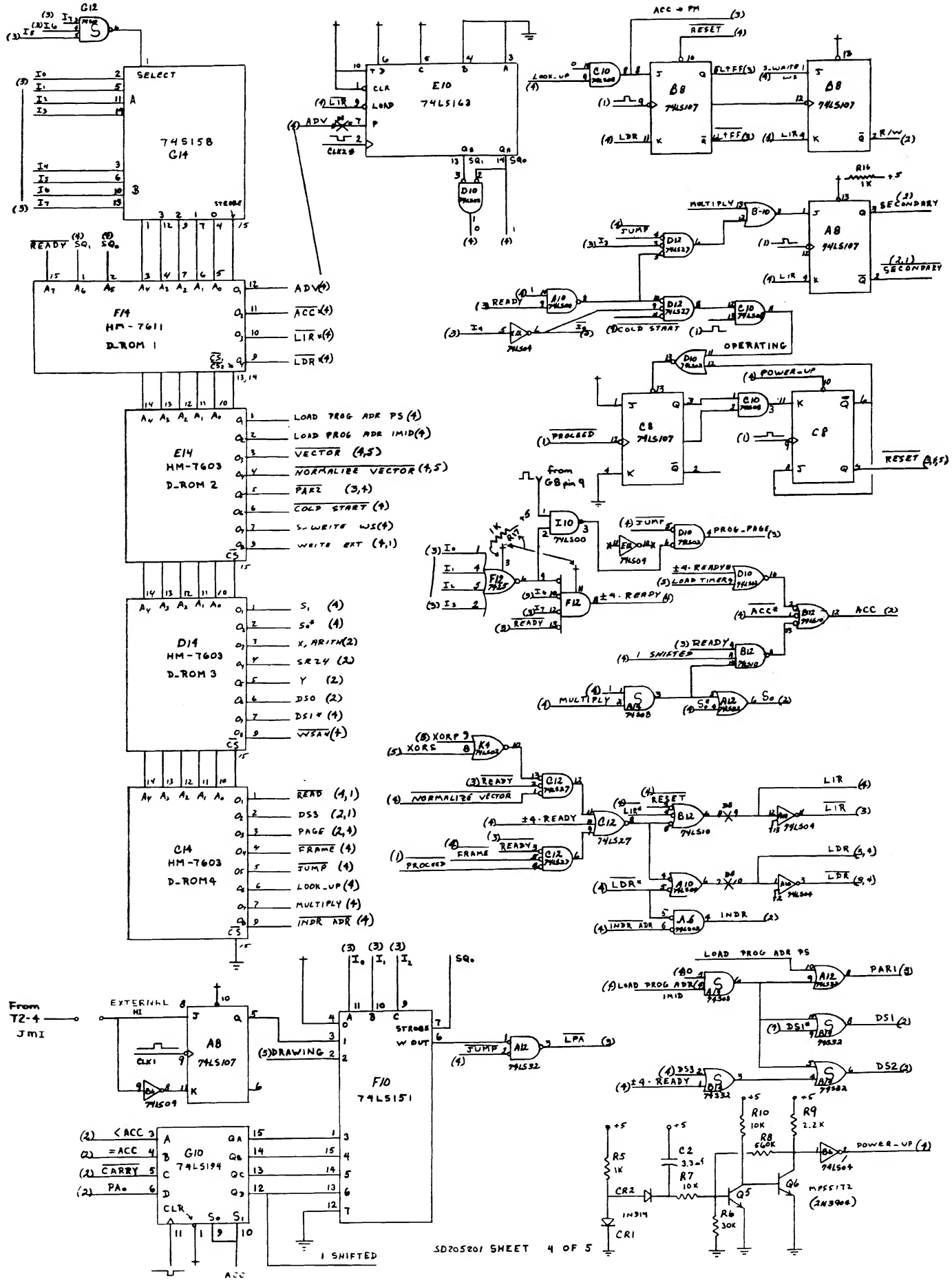
*OR 16-LEVEL INTENSITY CIRCUITRY

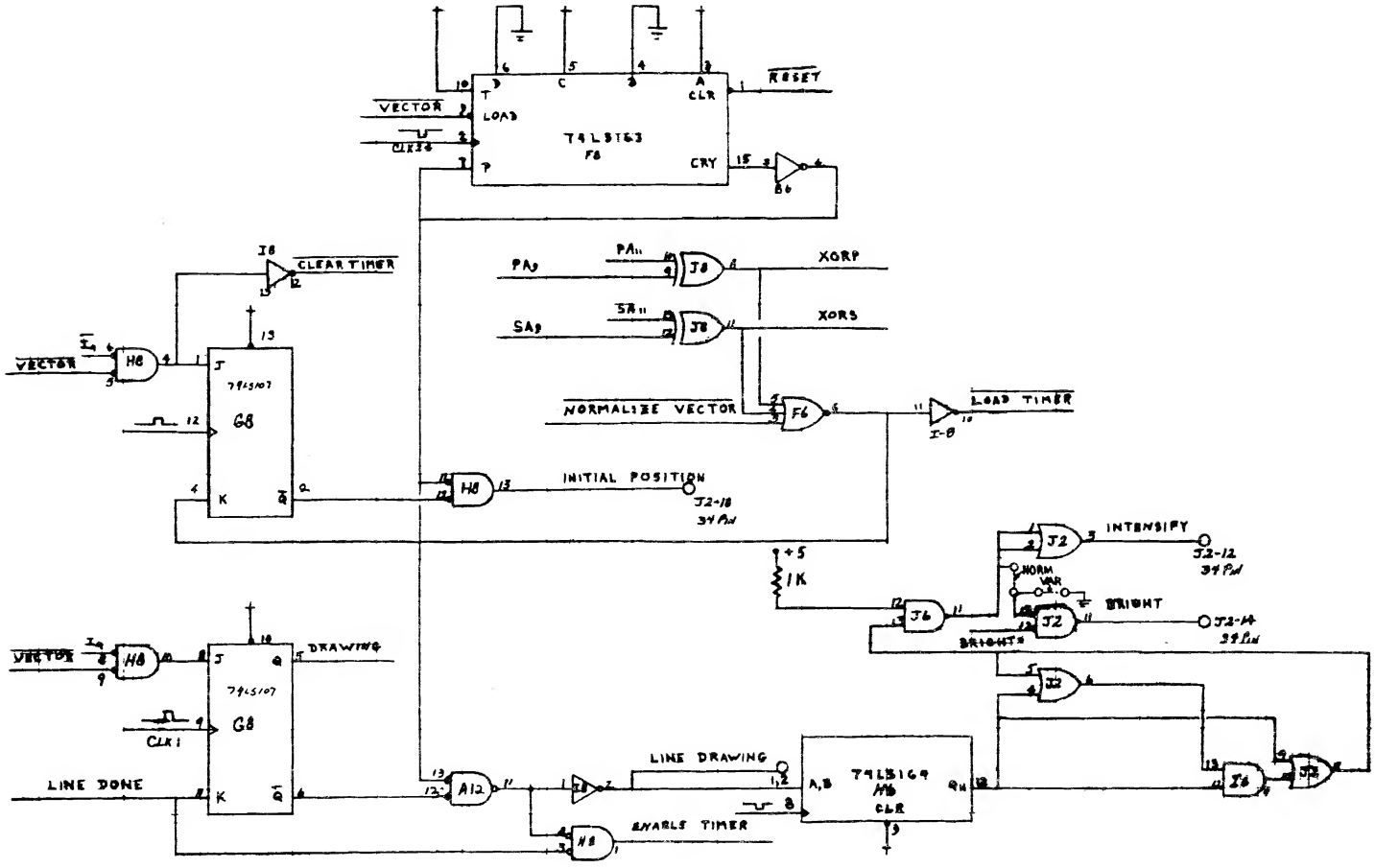


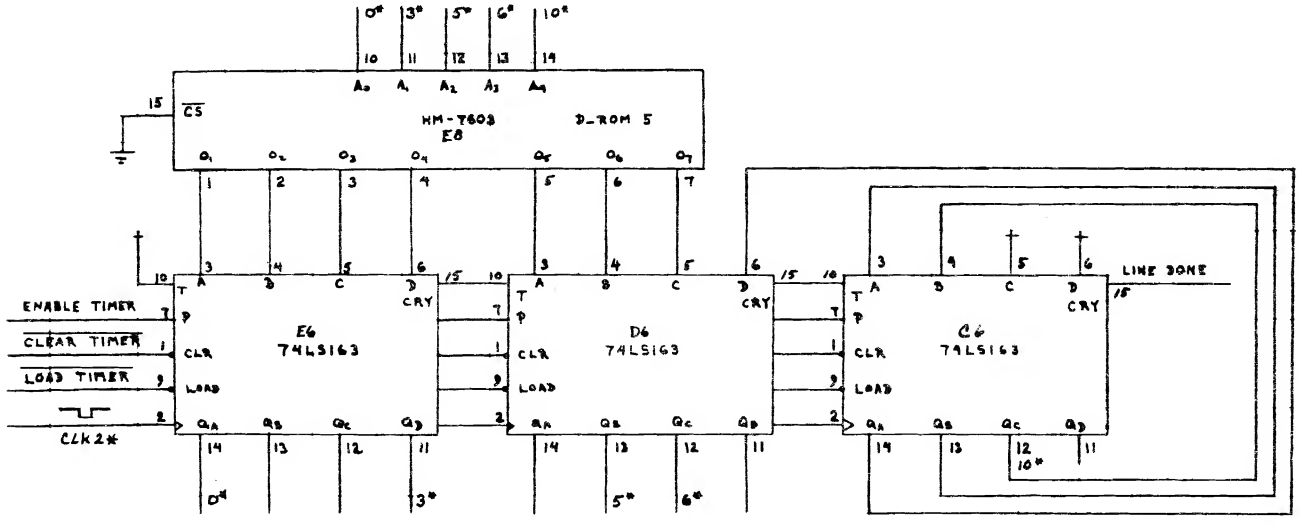
CINEMA RONICS	G		2-79	PA
LOGIC DIAGRAM	REV		DATE	BY
DATE 1/25/79	APPROVED			
SD205201	SHEET 1 OF 5			

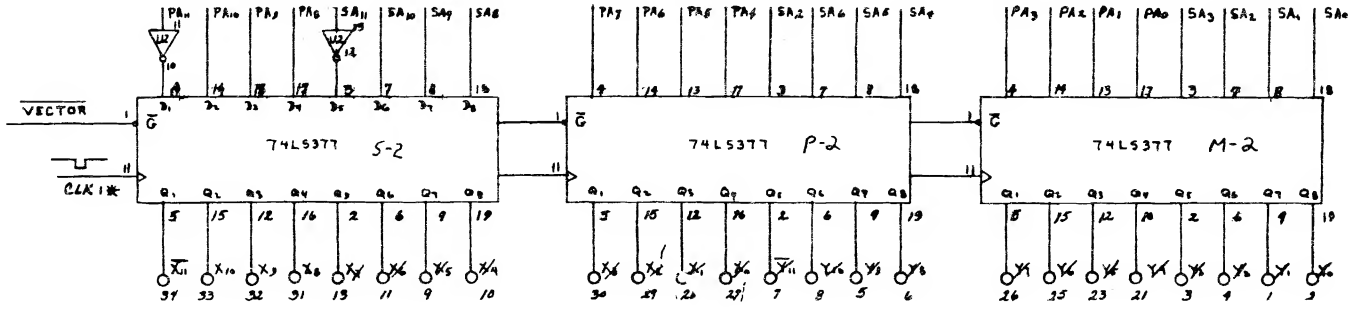

T2 74LS257
R2 74LS257
N2 74LS257
T4 74LS194
R4 74LS194
N4 74LS194
S4 74LS194
P4 74LS194
M4 74LS194
L4 T45182
N6 25LS181
M6 25LS181
L6 25LS181
N9 74LS85
M9 74LS85
L9 74LS85
N11 74LS157
M11 74LS157
L11 74LS157
J12 74LS298
H12 74LS194
9101C
M14
L14
X, ARITH
ACC
SECONDREY
READ_X
CLK 1 M
PAGE

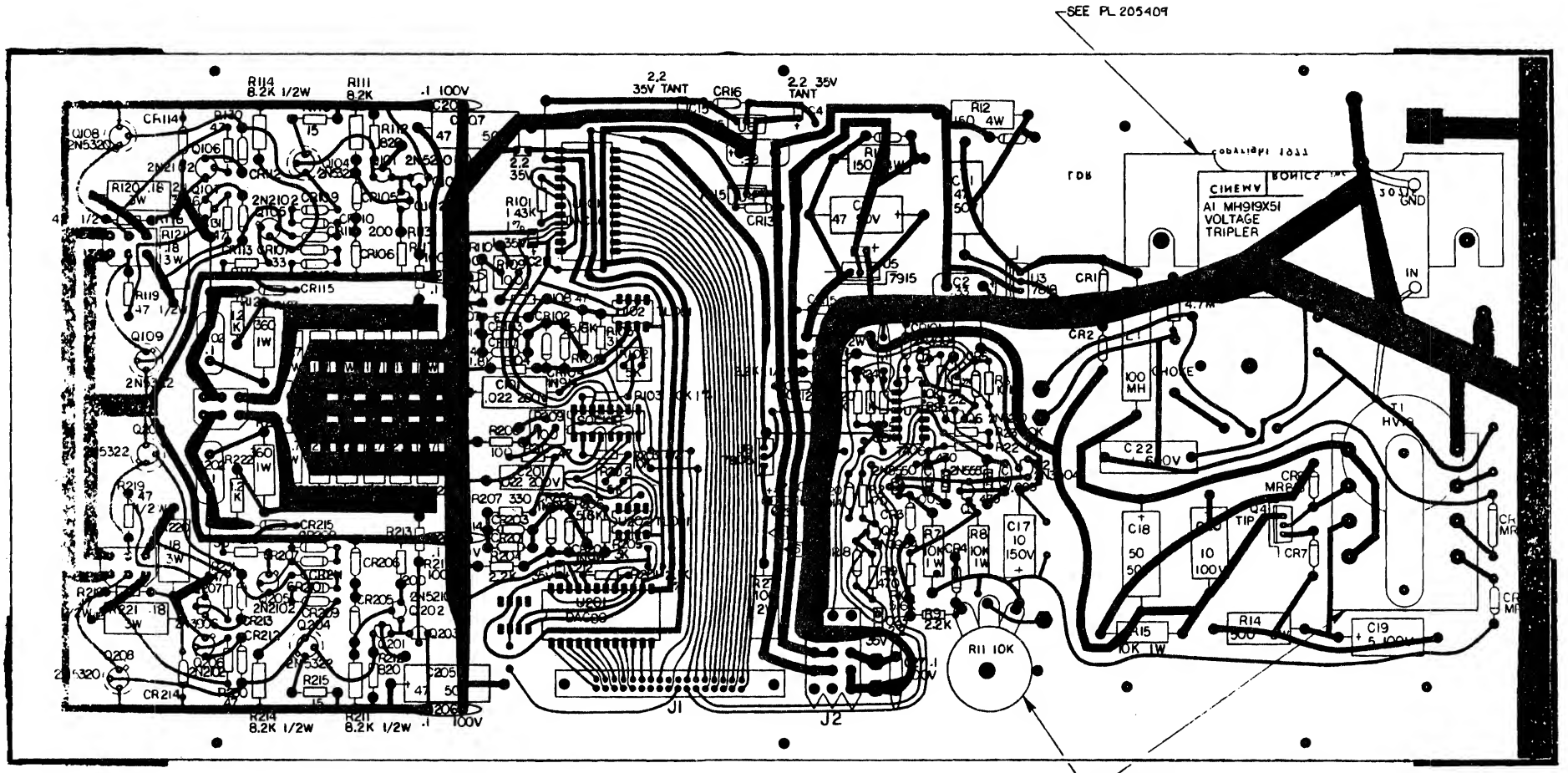

PAR1
PAR2
LPA
IPC
RESET
L1FF
74LS194
P13
74LS163
S11
74LS157
S9
74LS377
R13
74LS163
R11
74LS157
R9
74LS163
P11
74LS157
P9
CARRY
STROBE
SELECT
LOAD
A'0
VCC
GND
NOTE — SEE DWG 2480 FOR PROM MAP
U7
2616 OR 825181 OR 82S27-4
P-ROM 4
R7
2616 OR 825181 OR 82S27-3
P-ROM 3
T7
2616 OR 825181 OR 82S27-2
P-ROM 2
P7
2616 OR 825181 OR 82S27-1
P-ROM 1
EVEN
ODD
ADDRESS MODE
RESET
1K
P6₁
PROG PAGE
J10
74S107
PG₀
U9
74LS175
T9
74LS175
U11
74LS157
T11
74LS157
STROBE
SELECT
JUMPER
LIR
T13
74LS377
S13
74LS377
LDR
CLK1*
J14
HM-7603
D-ROM 6
BRANCH
LDR
LPA
L1FF
IPC
ACC → PM
I19
74LS163
DELAY
LATCH
READY
SD205201 SHEET 3 OF 5


G12
74S158
G14
E10
74LS163
F14
HM-7611
D-ROM 1
E14
HM-7603
D-ROM 2
D14
HM-7603
D-ROM 3
C14
HM-7603
D-ROM4
ADV (4)
ACC (4)
LIR (4)
LDR (4)
LOAD PROG ADR PS (4)
LOAD PROG ADR IMID (4)
VECTOR (4,5)
NORMALIZE VECTOR (4,5)
PAR2 (3,4)
COLD START (4)
S-WRITE WS (4)
WRITE EXT (4,1)
S1 (4)
S0* (4)
X, ARITH (2)
SR24 (2)
Y (2)
DS0 (2)
DS1* (4)
WSAV (4)
READ (4,1)
DS3 (2,1)
PAGE (2,4)
FRAME (4)
JUMP (4)
LOOK_UP (4)
MULTIPLY (4)
INDR ADR (4)
ACC → PM
RESET (4)
LOOK_UP (4)
LDR (4)
LIR (4)
R/W (2)
MULTIPLY
JUMP (4)
SECONDARY
READY
COLD START (4)
OPERATING
POWER-UP (4)
PROCEED
RESET (4,5)
from G8 pin 9
JUMP (4)
PROG_PAGE (3)
±4·READY (4)
LOAD TIMER (5)
ACC (2)
I SHIFTED
MULTIPLY (4)
S0 (2)
XORP (5)
XORS (5)
NORMALIZE VECTOR (4)
±4·READY (4)
FRAME (4)
PROCEED (1)
LIR (4)
LDR (3,4)
INDR (2)
INDR ADR (4)
From T2-4 JMI
EXTERNAL NI
CLK1
DRAWING (5)
F10
74LS151
STROBE
W OUT
SQ0
JUMP (4)
LPA (3)
LOAD PROG ADR PS
LOAD PROG ADR IMID (4)
PAR1 (3)
DS1 (2)
DS2 (2)
±4·READY (4)
G10
74LS194
< ACC
= ACC
CARRY
PA0
CLR
I SHIFTED
ACC
R16 1K
R10 10K
R9 2.2K
R8 560K
R5 1K
R7 10K
R6 30K
C2 3.3mf
CR2 IN914
CR1
Q5
Q6
MPS5172
(2N3906)
POWER-UP (1)
SD205201 SHEET 4 OF 5


RESET
VECTOR
LOAD
CLK2*
74LS163
F8
CRY
CLEAR TIMER
LOAD TIMER
XORP
XORS
NORMALIZE VECTOR
INITIAL POSITION
J2-18
34 PIN
INTENSIFY
J2-12
34 PIN
NORM
VAR
BRIGHT
J2-14
34 PIN
+5
1K
DRAWING
CLK1
LINE DONE
LINE DRAWING
ENABLE TIMER
74LS107
74LS164


HM-7603
E8
D-ROM 5
ENABLE TIMER
CLEAR TIMER
LOAD TIMER
CLK2*
LINE DONE
E6
D6
C6
74LS163
CRY
CLR
LOAD


VECTOR
CLK1*
74LS377
S-2
P-2
M-2



NOTES:

1. ALL CAPACITOR VALUES ARE IN MICROFARADS.
2. ALL RESISTOR VALUES ARE IN OHMS, 1/4W UNLESS OTHERWISE SPECIFIED.
3. ALL DIODES ARE IN4003 UNLESS OTHERWISE SPECIFIED.

A	#22	BROWN 2"
B	#22	BROWN 3 1/4"
C	#18	BLACK 4 3/4"
D	#18	RED 9"
E	#18	BLUE 9"

0	BLACK	TWIST TOGETHER & CUT TO 10 1/4"
1	BROWN	
2	RED	12"
3	YELLOW	10"
4	GREEN	13"
5	BLUE	11 1/2"
6	WHITE	18"

MATERIAL:

FINISH: BREAK ALL SHARP EDGES AND REMOVE ALL BURRS

DRAWN BY: S. HURLBERT DATE 10/7

PROJECT ENGR: C. WILLIAMS DATE 10/7

RELEASE APPROV DATE

DO NOT SCALE DWG

UNLESS OTHERWISE SPECIFIED

SCALE: 2:1

CINEMATRONICS INC

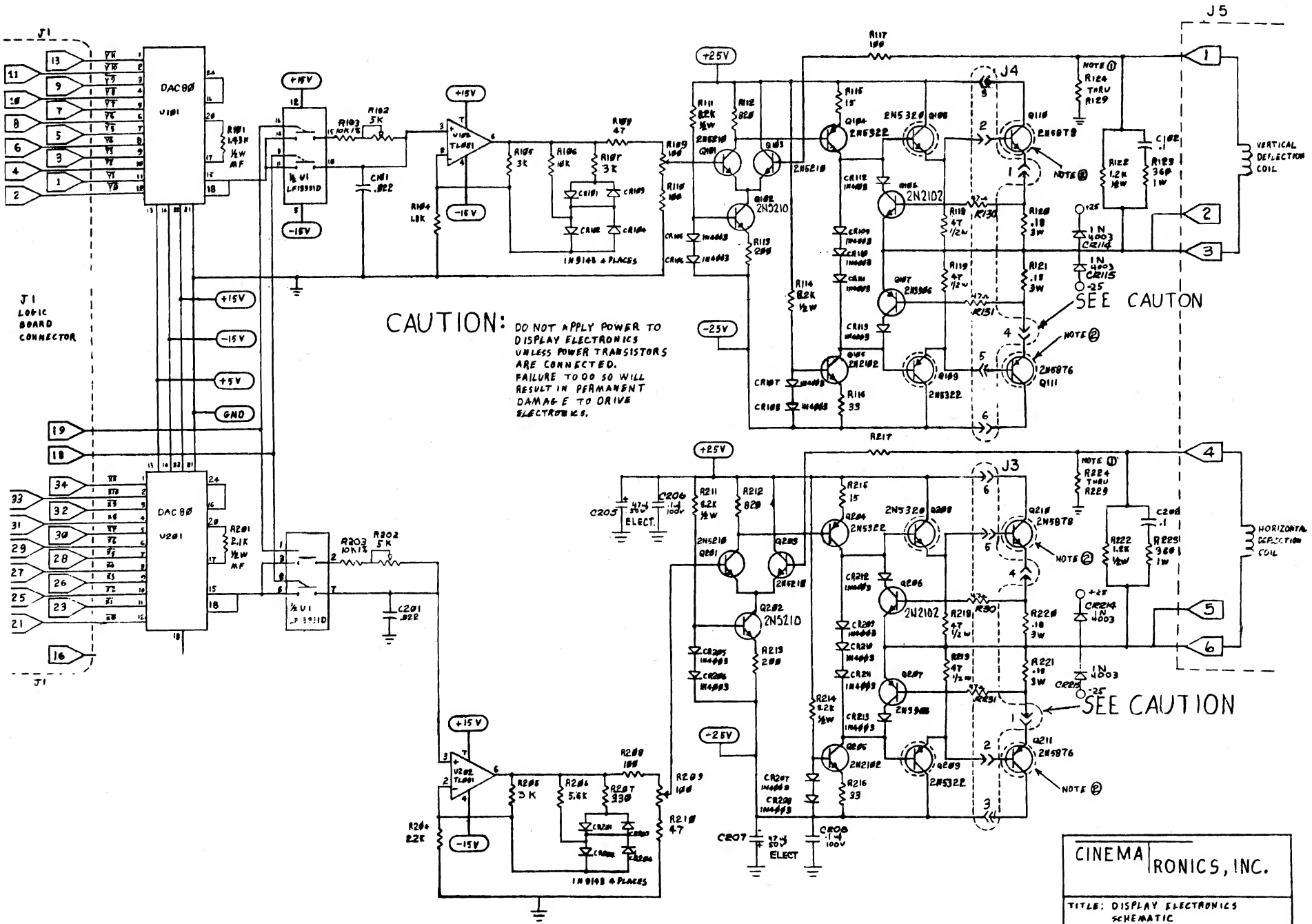
DWG TITLE: DISPLAY ELECTRONICS P.C. ASSEMBLY

SIZE D

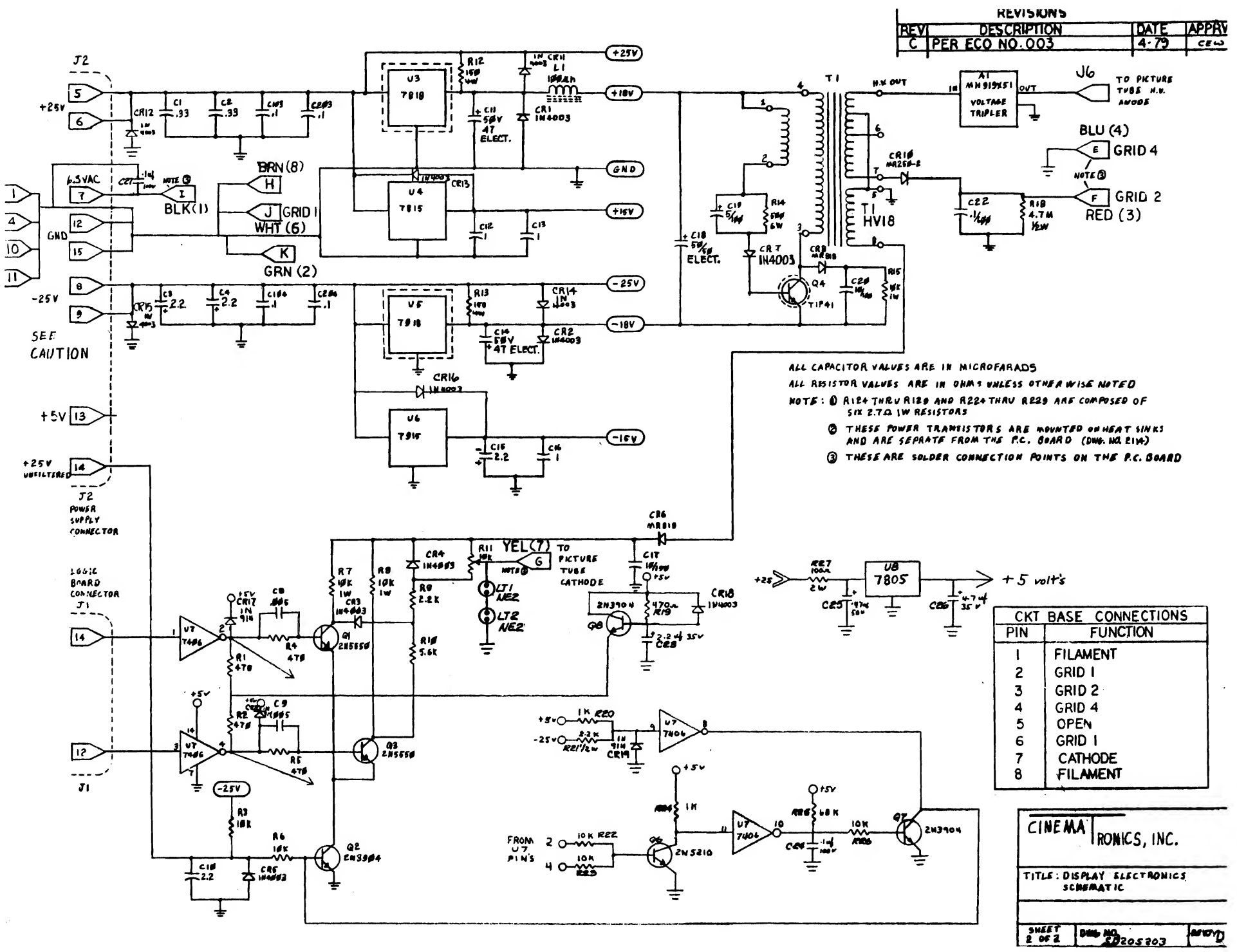
DWG NO. AE 205203

CODE IDENT

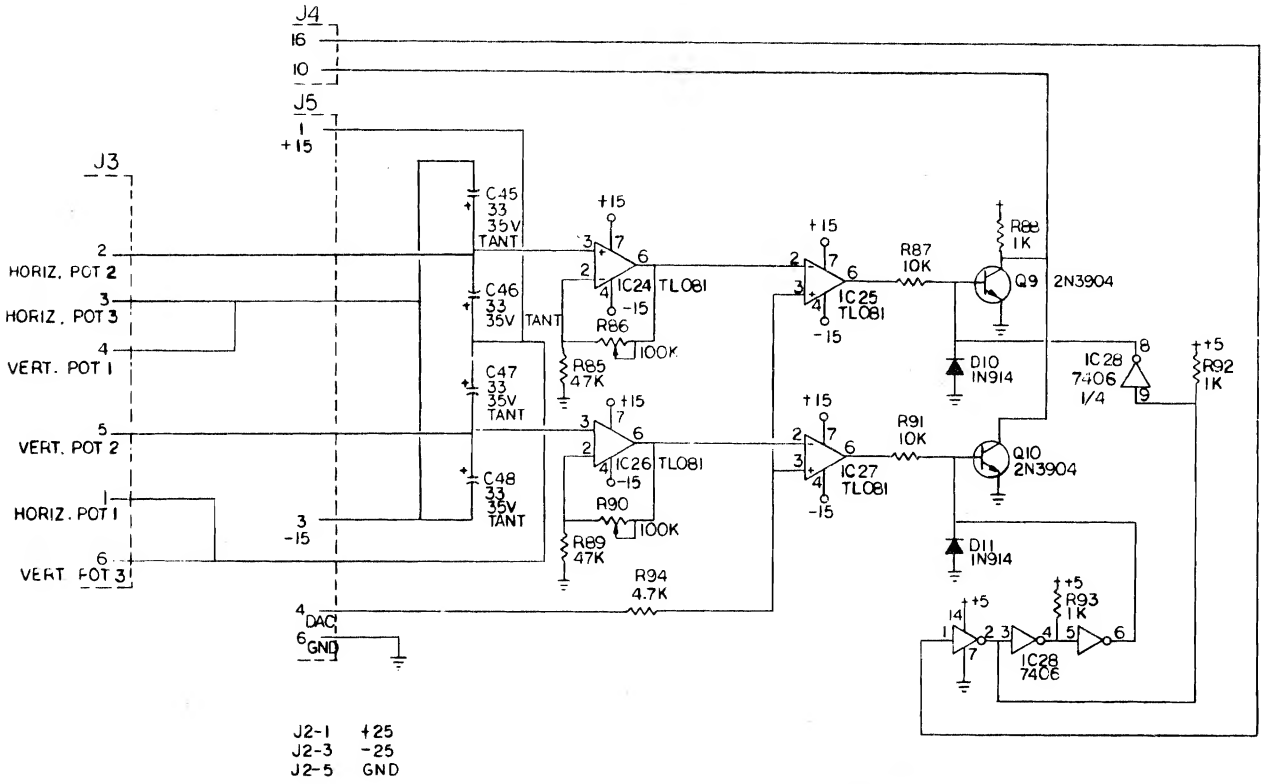
SHEET 1 OF



CINEMATRONICS, INC.	
TITLE: DISPLAY ELECTRONICS SCHEMATIC	
SHEET 1 OF 2	DWG NO SD205203 REV D


REVISIONS
REV | DESCRIPTION | DATE | APPRV
C | PER ECO NO. 003 | 4-79 | CEW
J2
+25V
-25V
GND
6.3VAC
SEE CAUTION
BRN (8)
BLK (1)
WHT (6)
GRN (2)
GRID 1
U3 7818
U4 7815
U5 7918
U6 7915
+25V
+18V
GND
+15V
-25V
-18V
T1
HV18
H.V. OUT
A1 MH919X51 VOLTAGE TRIPLER
J6
TO PICTURE TUBE H.V. ANODE
BLU (4)
GRID 4
GRID 2
RED (3)
NOTE ③
+5V
+25V UNFILTERED
J2 POWER SUPPLY CONNECTOR
LOGIC BOARD CONNECTOR J1
J1
YEL (7)
TO PICTURE TUBE CATHODE
LT1 NE2
LT2 NE2
U8 7805
+5 volt's
Q1 2N5550
Q2 2N3904
Q3 2N5550
Q4 TIP41
Q5 2N5210
Q6 2N3904
U7 7406
U8 7805
ALL CAPACITOR VALUES ARE IN MICROFARADS
ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE NOTED
NOTE: ① R124 THRU R128 AND R224 THRU R228 ARE COMPOSED OF SIX 2.7Ω 1W RESISTORS
② THESE POWER TRANSISTORS ARE MOUNTED ON HEAT SINKS AND ARE SEPARATE FROM THE P.C. BOARD (DWG. NO. 2114)
③ THESE ARE SOLDER CONNECTION POINTS ON THE P.C. BOARD
CKT BASE CONNECTIONS
PIN | FUNCTION
1 FILAMENT
2 GRID 1
3 GRID 2
4 GRID 4
5 OPEN
6 GRID 1
7 CATHODE
8 FILAMENT
CINEMATRONICS, INC.
TITLE: DISPLAY ELECTRONICS SCHEMATIC
SHEET 2 OF 2
DWG NO. ED205203
REV D

REVISIONS			
REV	DESCRIPTION	DATE	APPRD



JOYSTICK CIRCUITRY

4 ALL DIODES ARE IN914 UNLESS OTHERWISE SPECIFIED.

3 C49 C50, AND C51 ARE BYPASS CAPS. (.1uf, 50V) FROM GROUND TO +5V.

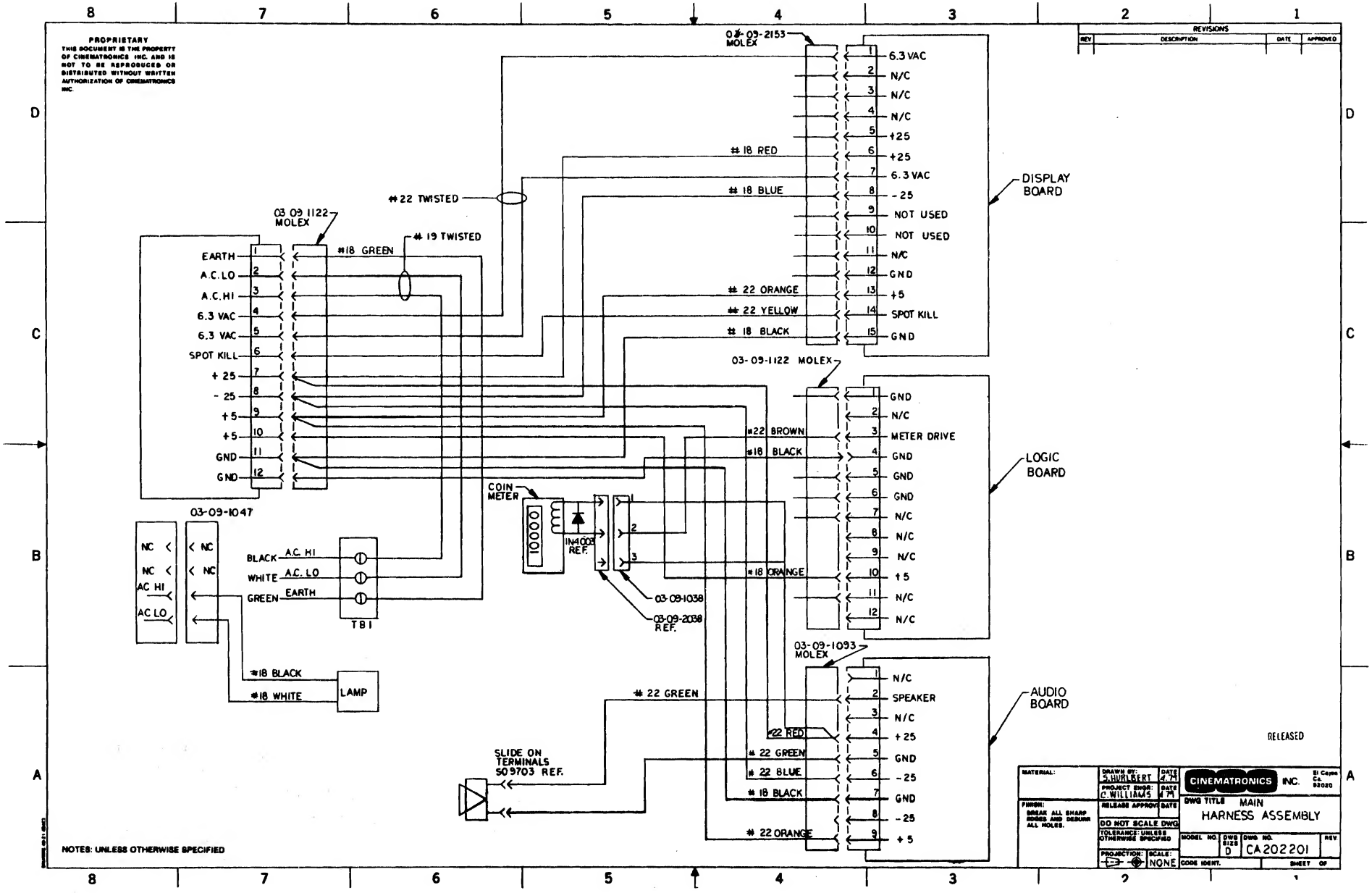
2 ALL RESISTOR VALUES ARE IN OHMS 1/4W, 5% UNLESS OTHERWISE SPECIFIED.

1. ALL CAPACITOR VALUES ARE IN MICROFARADS, 50V, DISC. UNLESS OTHERWISE SPECIFIED.

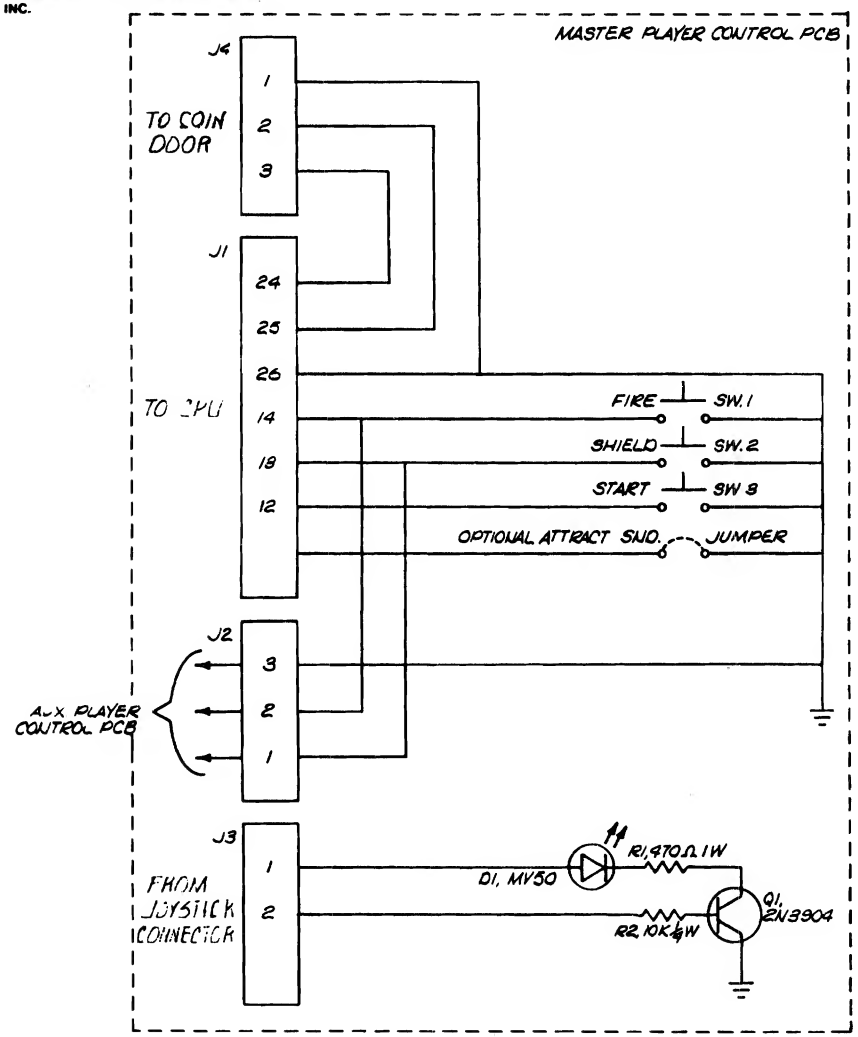
NOTES: UNLESS OTHERWISE SPECIFIED

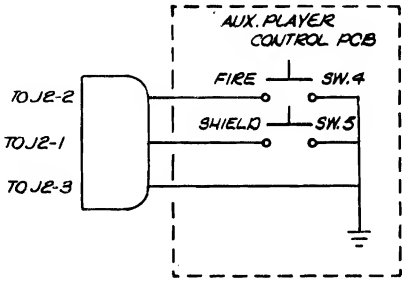
MATERIAL:	DRAWN BY: SCHUKERT 10-7	CINEMATRONICS INC	
	PROJECT ENGR: C. WILLIAMS 10-7	DWG TITLE SCHEMATIC AUDIO BOARD TAILGUNNER	
FINISH:	RELEASE APPROV: DATE		
	DO NOT SCALE DWG	MODEL NO	DWG SIZE D
	TOLERANCE: UNLESS OTHERWISE SPECIFIED	DWG NO. SD205202	REV X
	PROJECTION: SCALE: NONE	CODE IDENT.	SHEET 2 OF

8 7 6 5 4 3 2 1


PROPRIETARY
THIS DOCUMENT IS THE PROPERTY OF CINEMATRONICS INC. AND IS NOT TO BE REPRODUCED OR DISTRIBUTED WITHOUT WRITTEN AUTHORIZATION OF CINEMATRONICS INC.
REVISIONS
REV DESCRIPTION DATE APPROVED
03-09-2153 MOLEX
1 6.3 VAC
2 N/C
3 N/C
4 N/C
5 +25
6 +25
7 6.3 VAC
8 -25
9 NOT USED
10 NOT USED
11 N/C
12 GND
13 +5
14 SPOT KILL
15 GND
DISPLAY BOARD
#18 RED
#18 BLUE
#22 ORANGE
#22 YELLOW
#18 BLACK
#22 TWISTED
#19 TWISTED
#18 GREEN
03 09 1122 MOLEX
EARTH 1
A.C. LO 2
A.C. HI 3
6.3 VAC 4
6.3 VAC 5
SPOT KILL 6
+25 7
-25 8
+5 9
+5 10
GND 11
GND 12
03-09-1122 MOLEX
GND 1
N/C 2
METER DRIVE 3
GND 4
GND 5
GND 6
N/C 7
N/C 8
N/C 9
+5 10
N/C 11
N/C 12
LOGIC BOARD
#22 BROWN
#18 BLACK
#18 ORANGE
COIN METER
100000
IN4003 REF.
03-09-1038
03-09-2038 REF.
03-09-1047
NC
NC
AC HI
AC LO
BLACK A.C. HI
WHITE A.C. LO
GREEN EARTH
TB1
#18 BLACK
#18 WHITE
LAMP
03-09-1093 MOLEX
1 N/C
2 SPEAKER
3 N/C
4 +25
5 GND
6 -25
7 GND
8 -25
9 +5
AUDIO BOARD
#22 GREEN
#22 RED
#22 GREEN
#22 BLUE
#18 BLACK
#22 ORANGE
SLIDE ON TERMINALS 509703 REF.
RELEASED
NOTES: UNLESS OTHERWISE SPECIFIED
MATERIAL:
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.
DRAWN BY: S.HURLBERT DATE 4-79
PROJECT ENGR: C.WILLIAMS DATE 4-79
RELEASE APPROV. DATE
DO NOT SCALE DWG.
TOLERANCE: UNLESS OTHERWISE SPECIFIED
PROJECTION: SCALE: NONE
CINEMATRONICS INC. El Cajon Ca. 92020
DWG TITLE MAIN HARNESS ASSEMBLY
MODEL NO. DWG SIZE D DWG NO. CA202201 REV
CODE IDENT. SHEET OF

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED





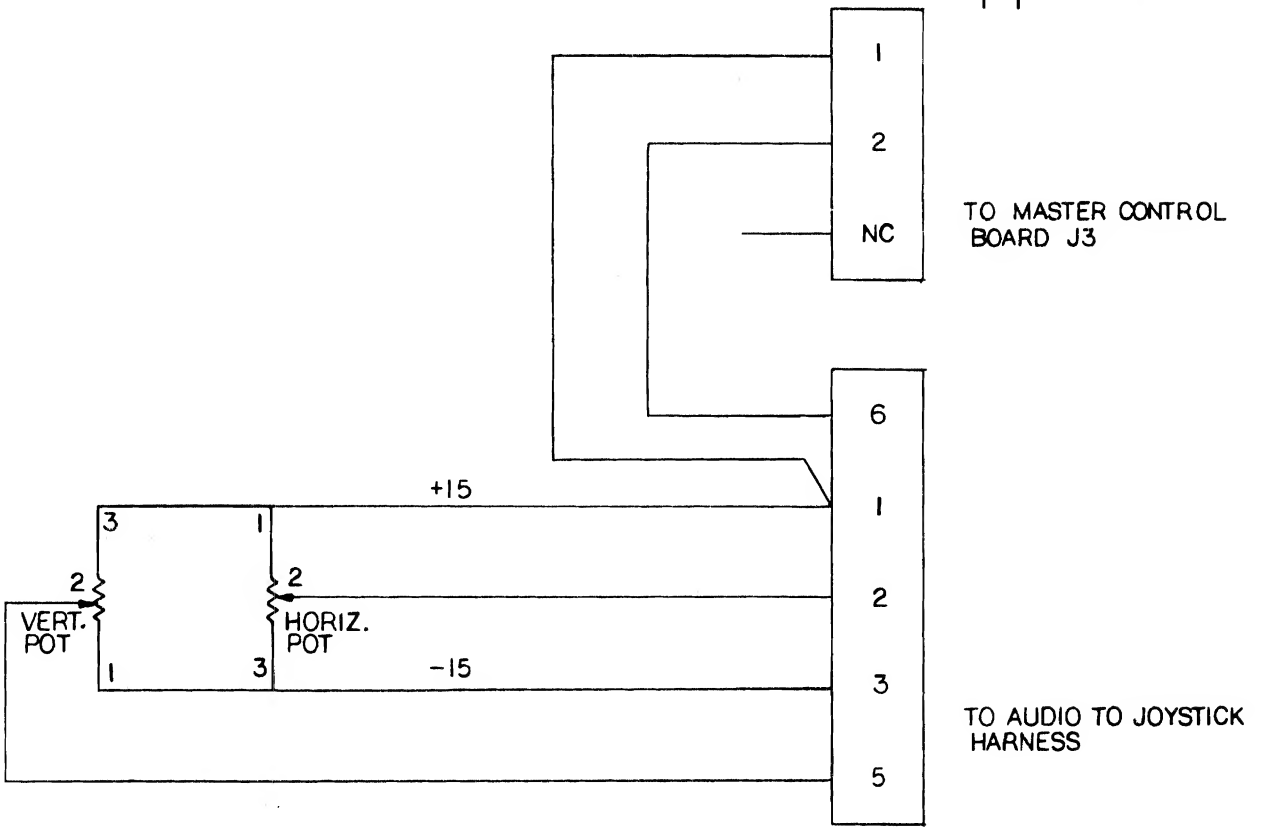
NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: A. Thacker	DATE 10-08-82	CINEMATRONICS INC. El Cajon Ca. 92020
	PROJECT ENGR: C. Wilson	DATE	DWG TITLE: SCHEMATIC DIAGRAM - PLAYER CONTROL, TAILGUNNER
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	RELEASE APPROV: CEW	DATE 10-7-82	
	DO NOT SCALE DWG		MODEL NO. / DWG SIZE C / DWG NO. 80205205 / REV. A
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		CODE IDENT. / SHEET 1 OF 1
	PROJECTION:	SCALE: NONE	

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

3 PIN FEMALE HOOKUP

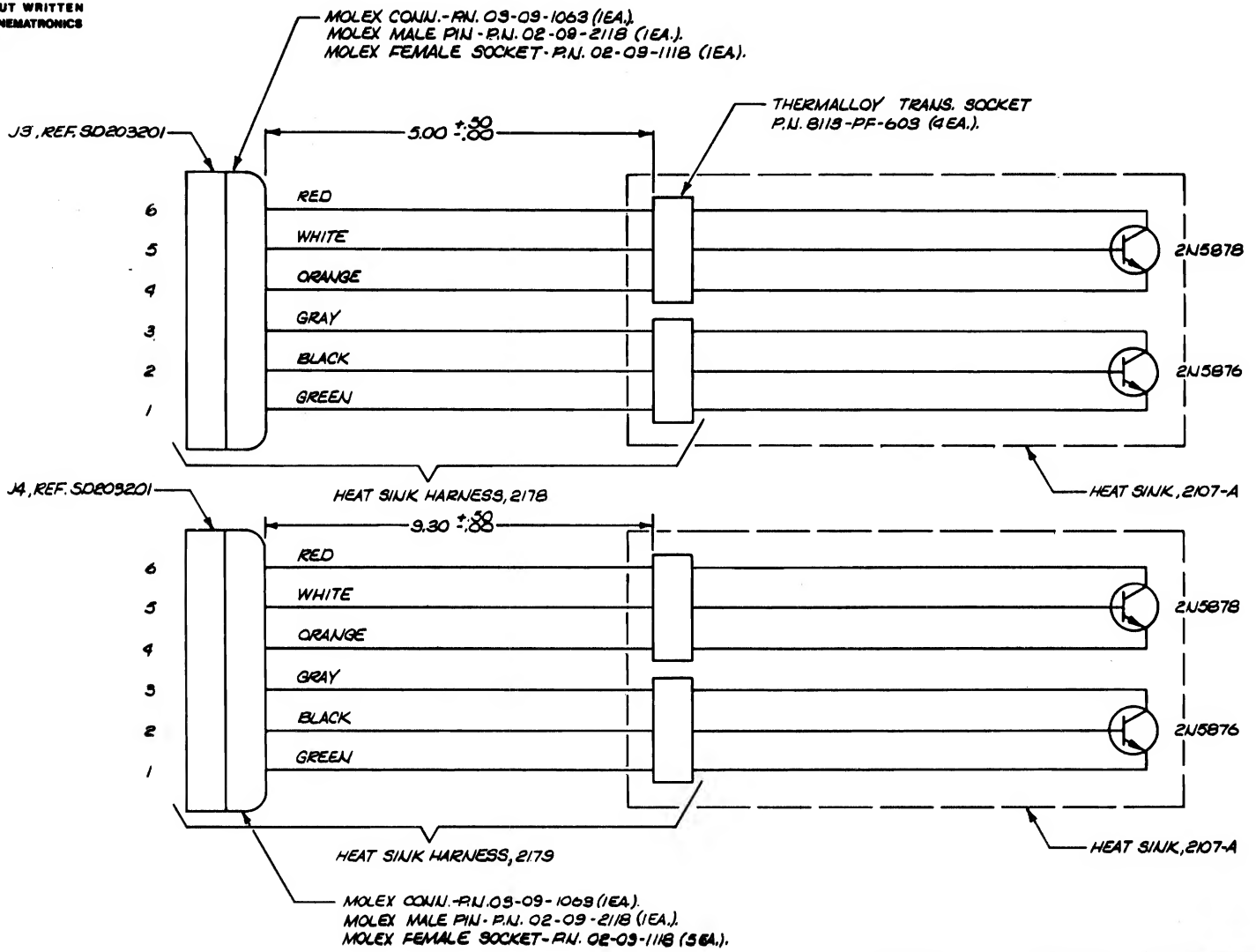


NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: S.HURLBERT	DATE 10-79	CINEMATRONICS INC. El Cajon Ca. 92020
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	PROJECT ENGR: C.WILLIAMS	DATE 10-79	DWG TITLE JOYSTICK ASSY SCHEMATIC DIAGRAM
	RELEASE APPROV: CEW	DATE 10-79	
	DO NOT SCALE DWG		MODEL NO. / DWG SIZE C / DWG NO. SD205413 / REV A
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		
	PROJECTION:	SCALE: NONE	CODE IDENT. / SHEET 1 OF 1

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



NOTES: UNLESS OTHERWISE SPECIFIED

MATERIAL:	DRAWN BY: A. Thomas	DATE 8-7-79	CINEMATRONICS INC. El Cajon Ca. 92020
FINISH: BREAK ALL SHARP EDGES AND DEBURR ALL HOLES.	PROJECT ENGR: C. Williams	DATE 8-7-79	DWG TITLE SCHEMATIC, VERTICAL & HORIZONTAL HEAT SINK ASSY.
	RELEASE APPROV: C E W	DATE 8-7-79	
	DO NOT SCALE DWG		MODEL NO. / DWG SIZE C / DWG NO. SD205405 / REV A
	TOLERANCE: UNLESS OTHERWISE SPECIFIED		
	PROJECTION:	SCALE: NONE	CODE IDENT. / SHEET 1 OF 1

4 3 2 1